

# CYTEC

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RECEIVED

NOV 17 1994

JOEL JEROME

November 14, 1994

Mr. Haiyesh Shah  
Case Manager  
New Jersey Department of Environmental Protection  
Bureau of Federal Case Management  
Division of Responsible Party Site Remediation  
401 East State Street, 5th Floor West  
Trenton, NJ 08625-0028

Re: Remedial Action Plan Addendum, Carteret Impoundments  
Carteret, New Jersey

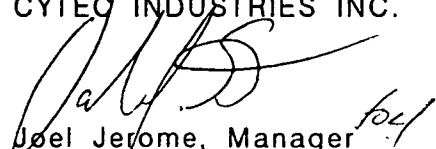
Dear Mr. Shah:

Cytec Industries Inc. (Cytec) has completed the Remedial Action Plan Addendum (RAPA) in accordance with the Remedial Action Plan approved by the New Jersey Department of Environmental Protection. Two copies of the RAPA are enclosed with this letter.

If you have any questions, please contact me at (908) 862-6000, extension 486.

Sincerely,

CYTEC INDUSTRIES INC.

  
Joel Jerome, Manager  
Site Remediation

JJ/DJS/jnb  
1994382.AA  
Enclosure

cc: A.N. Johnson, P.E., Blasland, Bouck & Lee, Inc.  
D.J. Stout, Blasland, Bouck & Lee, Inc.

*Handwritten notes:*  
M/S/jnb  
RPA  
12/14/94  
11/14/94

# REPORT

D. J. STOUT

## REMEDIAL ACTION PLAN ADDENDUM

Carteret Impoundments  
Borough of Carteret, New Jersey

Cytex Industries Inc.

November 1994  
Revised February 1995



**BLASLAND, BOUCK & LEE, INC.**  
ENGINEERS & SCIENTISTS

**REMEDIAL ACTION PLAN ADDENDUM**

**CARTERET IMPOUNDMENTS  
BOROUGH OF CARTERET, NEW JERSEY**

**CYTEC INDUSTRIES INC.**

**FEBRUARY 1995**

**BLASLAND, BOUCK & LEE, INC.  
8 SOUTH RIVER ROAD  
CRANBURY, NEW JERSEY 08512**

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## **SECTION 1 - INTRODUCTION**

### **1.1 Site Background**

Cytec Industries Inc. (Cytec) owns and operates a chemical manufacturing plant, known as the Warners Plant, located at Tremley Point on the Rahway River at the river's confluence with the Arthur Kill in Linden, New Jersey. Cytec and its predecessor, American Cyanamid Company, (Cyanamid) have owned and operated this 32-acre facility since 1917. Across the Rahway River from the Warners Plant, Cytec owns approximately 110 acres of land in Carteret, Middlesex County, New Jersey. From the 1930s to 1974, Cytec operated six bermed impoundments on the Carteret property for the management of residues generated from the production of alum and yellow prussiate of soda (YPS). This area, hereafter referred to as the Carteret Impoundments, is not contiguous with the Warners Plant.

In August 1986, the New Jersey Department of Environmental Protection (NJDEP) issued Cyanamid a New Jersey Pollutant Discharge Elimination System/Discharge to Ground Water (NJPDES/DGW) permit No. NJ0061611 to monitor ground-water quality at the Carteret Impoundments. In September of 1990, Cyanamid and the NJDEP signed an Administrative Consent Order (ACO) which, in part, required Cyanamid to investigate and remediate potential contamination at the Warners Plant. Additional information regarding the Warners Plant is provided in the Phase I and Phase II Remedial Investigation (RI) Reports {Blasland, Bouck & Lee (BBL), 1992; 1993}. In February 1990, NJPDES/DGW permit No. NJ0061611 was withdrawn by NJDEP.

In December of 1993, ownership of these properties was transferred to Cytec, and an RI Work Plan (RIWP) was submitted to NJDEP in response to an amendment to the 1990 ACO. Comments were received from the NJDEP on the RIWP on February 22, 1994. In response to comments received on the RIWP,

Cytec submitted a Remedial Action Plan (RAP) to the NJDEP on April 21, 1994. The RAP outlines the procedures to be implemented for the operation, maintenance, and monitoring program for the Carteret Impoundments. This report is an Addendum to the RAP.

## **1.2 Site Description**

The Carteret Impoundments are located on a 110-acre tract encompassing 21 lots on three tax map blocks in Carteret, Middlesex County, New Jersey: Block 9.03, Lot 21; Block 10, Lots 8, 9, 10, and 12 through 21; and Block 11.01, Lots 8, 10 through 14, and 28. Figure 1-1 illustrates the site location.

The area encompassing the Carteret Impoundments is zoned for industrial use only. The Rahway River bounds the north and east portions of the site. American Oil Company and Phillips Petroleum operate adjacent petroleum storage facilities to the south and southeast property bounds, respectively. The Borough of Carteret owns a closed municipal landfill to the west, across Cross Creek. Industrial Reclamation Service, Inc. operates a salvage yard along the western property boundary, where unauthorized extension of salvage operations onto Cytec property was corrected by removal actions in 1987 during monitoring well installation.

## **1.3 Summary of Previous Investigations**

Extensive environmental investigations have generated considerable information describing land-use, geology, hydrogeology, hydrology, and prevailing environmental quality at the Carteret Impoundments. This section provides a summary of pertinent site-related information, emphasizing prior investigations completed to evaluate conditions at the Carteret Impoundments.

From the 1930s to 1974, an estimated 2 million tons of alum and YPS production residues were deposited in the six Carteret Impoundments. The six impoundments differ in size and capacity; therefore, the amount and thickness of residues deposited in each of them varies. The RIWP (BBL, 1993) presents a more detailed discussion of the historical operating procedures related to the Carteret Impoundments.

The residues deposited at the Carteret Impoundments are not RCRA hazardous wastes. Numerous samples of the residues have been analyzed to evaluate their chemical composition, physical characteristics, and potential toxicity. EP Toxicity testing, free cyanide analyses, and pH measurements have been completed for waste characterization of residue samples from each of the six impoundments. Results for these analyses are provided in Appendix C of the RIWP (BBL, 1993). Composite samples of the residue samples collected in 1981 from Impoundments 1, 2, and 3 and samples collected in 1986 from Impoundments 2, 3, 4, 5, and 6 demonstrate that the impounded residues are not RCRA hazardous wastes by characteristics.

To assess whether the Toxicity Characteristic Leaching Procedure (TCLP) protocol for hazardous waste classification would produce different results than the EP toxicity testing, a desk-top evaluation was presented in the RAP (BBL, 1994). The evaluation suggests that extraction testing using TCLP would most likely reach the same conclusion as previous EP toxicity testing: residues contained in the impoundments are not hazardous by characteristic evaluation.

In repeated analyses completed since the late 1950s, the impounded residues consistently revealed a chemical composition of inorganic ions and salts characteristic of alum and YPS. Analytical data from the late 1950s describe the neutral residue composition in Impoundments Nos. 1 and 2 as predominantly gypsum [ $\text{CaSO}_4$  (90 percent)] and calcium carbonate [ $\text{CaCO}_3$  (2 to 3 percent)]. A 1974 analysis characterizes the residue from alum production as aluminum

oxide ( $\text{Al}_2\text{O}_3$ ), 34 to 43 percent; silica ( $\text{SiO}_2$ ), 33 to 40 percent; sulfate ( $\text{SO}_4^{2-}$ ), 12 to 17 percent; and sodium (Na), 7 to 9 percent.

Organic compounds have been infrequently detected in residue samples from the Carteret Impoundments in sampling in 1981 and 1991. In 1981, the New Jersey Department of Transportation (NJDOT) collected six samples of the impounded residue for analysis for volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), pesticides, six metals, and cyanide. Two samples each were collected from Impoundments Nos. 1, 2, and 3. Pesticides and PCBs were not detected in any of the six samples analyzed.

Samples of the residue collected in 1981 were slightly alkaline and enriched with aluminum and total cyanide from the alum and YPS production processes. Concentrations of trace metals, chromium, copper, lead, manganese, and zinc, were comparable to or less than background conditions reported for New Jersey soils (NJDEP, 1992). Total cyanide ranged from 622 to 2,374 mg/kg. Insoluble cyanide complexes comprised approximately 75 percent of the cyanide detected (NJDOT, 1981). Cyanide concentrations were less than the NJDEP soil cleanup criterion.

In 1991, the NJDEP collected and analyzed 10 impoundment residue samples. VOCs were not detected above detection limits or NJDEP soil cleanup criteria in the samples. Semivolatile organic compounds (SVOCs) detected in NJDEP's residue samples from Impoundments Nos. 2, 3, and 4 were below their respective non-residential direct contact and impact to ground water soil cleanup criteria. The exception was the only detection of benzo(a)pyrene, which was reported at 1.8 mg/kg in a sample from Impoundment No. 3. SVOCs were not detected in residue samples from Impoundment No. 5. Trace levels of ubiquitous polycyclic aromatic hydrocarbons, two common phthalates, and hexachlorobenzene were infrequently detected in several residue samples from

Impoundments Nos. 2, 3, and 4. Concentrations of these SVOCs were less than the NJDEP soil cleanup criteria.

Neither PCBs nor pesticides were detected above their respective NJDEP soil cleanup criteria in the NJDEP's residue samples.

Inorganic constituents reported in residue analyses from all impoundments were less than the NJDEP soil cleanup criteria. Inorganic constituents detected in the residue samples reflect the composition of alum and YPS. Aluminum, calcium, cyanide, iron, magnesium, and sodium were elevated relative to the other inorganics analyzed for. The maximum total cyanide concentration of 1,020 mg/kg was detected in a residue sample from Impoundment No. 3. Cyanide concentrations detected in all residue samples were orders of magnitude less than the NJDEP soil cleanup criterion. Tables 1-1 and 1-2 summarize the results of the chemical analyses of residue samples collected in 1981 and 1991.

The results of these extensive sampling efforts suggest that the quality of the residue when compared to the NJDEP soil cleanup criteria is acceptable, and the remainder of this report focuses on assessing the quality of ground water and surface water.

#### **1.4 Objectives of the Remedial Action Plan Addendum**

The RAP was written in response to NJDEP comments on the RIWP, and outlines the procedures to be implemented for the operation, maintenance, and monitoring program for the Carteret Impoundments. This RAP Addendum has been prepared to report on the supplemental activities completed pursuant to the RAP and draft RAP Addendum. In accordance with the NJDEP requirements, the RAP Addendum presents:

- results of a supplemental ground-water and surface water investigation;
- recommendations for site-specific III-B ground-water criteria; and

- a program for monitoring ground water underlying the Carteret Impoundments.

### **1.5 Report Organization**

Section 2 of this RAP Addendum presents methods and results of the Supplemental Field Investigation.

Section 3 discusses ground-water data supporting a III-B classification for ground water in the area of the site, along with the methodology and results for the preliminary site-specific alternate III-B ground-water criteria development.

Section 4 discusses the results of ground-water and surface water elevation measurements, in addition to providing an analysis of tidal effects on ground-water flow. The III-B ground-water criteria are then re-evaluated, and the revised criteria are compared to the analytical data.

A semi-annual Monitoring Plan and schedule to evaluate compliance with the III-B alternate ground-water quality criteria and several recommendations for field studies to confirm the assumptions used to describe the ground-water and surface water relationship for the development of III-B criteria development are provided in Section 5.



## SECTION 2 - SUPPLEMENTAL FIELD INVESTIGATION

This section presents the methods and findings of the Supplemental Field Investigation conducted in June 1994 in response to comments from the NJDEP on the RIWP (BBL, 1993) and on the RAP (BBL, 1994). The study was undertaken to provide additional hydrogeologic information for the development of a long-term ground-water monitoring program.

The objectives of the investigative efforts, conducted in June and December 1994, were focused on gaining a more in-depth understanding of the hydrogeologic conditions at the Carteret Impoundments. The objectives included the following:

- Installation and monitoring of well pairs to evaluate ground-water quality in the overburden and shallow bedrock aquifers downgradient of Impoundment Nos. 3 and 6;
- Installation of one monitoring well pair in the southwest corner of the Carteret property to monitor upgradient ground-water quality in the overburden and shallow bedrock aquifers;
- Surface water sampling and analysis at locations adjacent to Impoundment 1 to evaluate potential impacts of the impoundment on the surrounding water bodies;
- Ground-water sampling and analysis of all wells to evaluate ground-water quality relative to prior analyte results from quarterly monitoring;

- III-B criteria development based on the relationship between ground water and surface water.
- A semi-annual comprehensive monitoring program to evaluate ground-water quality relative to the developed III-B criteria.

The methods used to compile and evaluate data generated during the field investigation, and the integration of these data with existing information from other studies of the Carteret Impoundments, are described in Section 2.1 for activities implemented in June 1994 and Section 4 for additional activities completed in December 1994. These methods included:

- Construction of overburden stratigraphic cross-sections, to characterize site stratigraphy and to aid in the development of a conceptual model of site hydrogeology;
- Construction and interpretation of ground-water potentiometric contour maps to evaluate ground-water flow patterns, ground-water flow directions, and horizontal hydraulic gradients; and
- Collection of ground-water and surface water quality data, and comparison of those data to the New Jersey Ground Water Quality Criteria (NJAC 7:9-6.7) and to the Surface Water Quality Standards (NJAC 7:9-1:14), respectively, to estimate the significance of contaminant loadings to the overburden ground-water system and to the adjacent surface water body.

## **2.1 Supplemental Field Activities**

The Supplemental Field Program included:

- Installation of six additional monitoring wells in the shallow and bedrock ground-water units;
- Sampling and analysis of additional monitoring wells and of five existing well pairs;
- Sampling of surface water; and
- Ground-water elevation monitoring.

### **2.1.1 Monitoring Well Installations and Ground-Water Sampling Procedures**

To better characterize the nature and distribution of organic and inorganic constituents detected during prior sampling events at the Carteret Impoundments, six additional monitoring wells (CRT-6S, CRT-6D, CRT-7S, CRT-7D, CRT-8S, and CRT-8D) were installed as shallow and deep well clusters at the Carteret Impoundments between June 22 and June 28, 1994. The locations of these wells are presented in Figure 2-1:

- Southeast corner of Impoundment 2 (well No. CRT-8);
- Northwest of Impoundment 3 (well No. CRT-7); and
- Outside of Impoundment 6 northern berm (well No. CRT-6).

The wells were constructed following specifications outlined in the NJDEP Field Sampling Procedures Manual (1992). The locations of three well couplets were chosen to assess the potential effect of contaminants of concern within the impoundments on ground-water quality. Boreholes for the wells were advanced by B and B, Inc., a NJDEP-licensed driller, using air rotary, mud rotary, and hollow stem auger drilling methods.

Pilot borings with continuous split-spoon sampling were advanced at each of the three well couplet locations to determine the subsurface stratigraphy. The geologic and well construction logs for these wells are contained in Appendix A. At all well locations, a photoionization detector (PID) was used to monitor the breathing zone during monitoring well installation.

Boreholes for the bedrock wells (CRT-6D, CRT-7D, and CRT-8D) were advanced using a 12-inch-diameter primary borehole through overburden via mud rotary drilling. An 8-inch stainless steel casing was set 5 feet into competent bedrock. Air rotary drilling was employed through the stainless steel casing to reach the first water-bearing zone within bedrock. The inner casing was constructed of Schedule 40, 4-inch PVC riser with a screened/ open rock interval set at the appropriate water-bearing zone.

The borings for shallow wells (CRT-6S, CRT-7S, and CRT-8S) were advanced with hollow stemmed augers. Shallow wells were constructed with 2-inch-diameter Schedule 40 PVC casings. Screen length in the shallow wells varied from 6 to 30 feet, based on the thickness of the monitoring zone of interest. Following installation, each well was developed using a submersible pump until the purge water was clear and free of suspended solids.

#### 2.1.2 Ground-Water Elevation Measurements

Ground-water elevation monitoring was performed to identify horizontal and vertical ground-water flow vectors and gradients. Depth to ground-water from the top of inner casing (TOC) was collected from pre-existing monitoring wells (CRT-1S, CRT-1D, CRT-2S, CRT-2D, CRT-3S, CRT-3D, CRT-4S, CRT-4D, CRT-5S, and CRT-5D), as well as the newly installed monitoring wells (CRT-6S, CRT-6D, CRT-7S, CRT-7D, CRT-8S, and CRT-8D) at low tide (0900) on July 13, 1994 and at high tide (1400) on July 14,

1994. Tidal conditions were approximated based on subjective visual observation of water elevation in the Rahway River. Actual ground-water elevations were determined by subtracting depth to water from TOC elevation.

#### 2.1.3 Ground-Water Sampling Procedures

Ground-water samples were collected in accordance with the procedures outlined in the NJDEP Field Sampling Procedures Manual, 1992. Ground-water sampling of all on-site wells took place on July 13 and 14, 1994. Disposable sampling equipment (i.e., pre-decontaminated disposable Teflon bailers and bailer rope) was used where possible to ensure collection of representative samples and to minimize the potential for sample cross-contamination. The 2-inch submersible pump used to purge the bedrock well water was decontaminated in between evacuations.

Ground-water sample collection procedures were as follows:

1. The well name and NJDEP permit number were cross-referenced against the site location map and the well data sheet, to assure the proper well designation.
2. Clean plastic sheeting was placed on the ground around the monitoring well to establish a clean working/sampling zone. All sampling equipment placed on the plastic sheeting was either disposable or decontaminated.
3. The well was opened and the head space was scanned with the PID for health and safety purposes. The PID readings were recorded in the field log book.

4. Initial ground-water elevations were collected using an electronic water-level probe. These elevations were recorded in the field log book and used to calculate the volume of well water to purge.
5. Disposable discharge tubing was attached to the decontaminated submersible purge pump and lowered into bedrock wells. A peristaltic pump with dedicated polyethylene tubing was used to purge the shallow sand and gravel wells.
6. Before, during, and after purging, grab samples were collected and measured for temperature, conductivity, pH, color, and turbidity to ensure that ground-water conditions were stable.
7. Following completion of bedrock well purging, the pump and disposable tubing were removed and pumps decontaminated. For the overburden wells, the polyethylene tubing was removed from the well and discarded.
8. A dedicated disposable Teflon bailer was used to collect each ground-water sample. The sample was poured directly into the laboratory-supplied glassware immediately upon removal from the well. Pre- and post-sample field parameter measurements were collected to ensure water conditions did not change during sampling.

Ground-water samples were analyzed for volatile organic compounds (VOCs), total and filtered metals, chloride, sulfate, total and free cyanide,

and total dissolved solids. Equipment field blanks were collected at a rate of one sample per analytical parameter per day. Blind duplicate samples were collected at a rate of one duplicate per 20 ground-water samples, to assess analytical precision. One matrix spike and matrix spike duplicate sample were also collected to assess potential sample matrix effects on analytical methods. A VOC trip blank accompanied all analytical sample shipments that included samples for VOC analyses.

All ground-water samples were stored immediately in coolers with ice and shipped to the analytical laboratory via overnight laboratory courier.

#### 2.1.4 Surface Water Sampling Procedures and Methodologies

Surface water sampling locations were selected to monitor potential contaminant of concern migration from Impoundment 1. It was previously determined that the installation of ground-water monitoring wells at Impoundment 1 would not be possible due to its physical inaccessibility. Surface water samples were collected from three separate locations on Deep Creek. These sampling locations were selected and NJDEP was notified in a letter dated June 17, 1994. The objectives of the surface water sampling were:

- to monitor surface water quality in Deep Creek adjacent to and downstream of Impoundment 1; and,
- to assess the potential relationship between ground-water discharge from Impoundment 1 and surface water quality.

The three sampling locations in Deep Creek were as follows: (1) SW-1, adjacent to the southwest corner of Impoundment 1; (2) SW-2, adjacent to the eastern side of Impoundment 1; and (3) SW-3, north and downstream of Impoundment 1. The approximate sample locations are

shown in Figure 1. Locations were identified in the field using topographic maps and by placing flagged poles at the designated sample sites. Surface water samples were collected at a high tidal stage on July 15, 1994.

In accordance with NJDEP (1992) sampling procedures, one grab sample was extracted at each location by dipping a bottle in the water.

This sampling approach was used due to the shallowness of the creek. In addition, pH and temperature were measured in the field. Surface water samples were analyzed for Target Compound List (TCL) VOCs, and Target Analyte List (TAL) inorganics (dissolved and total metals), plus total and free cyanide, sulfate, chloride, and total dissolved solids (TDS). The pH and conductivity were recorded using a portable meter with temperature-compensating pH and conductivity electrodes. Turbidity was measured in Nephelometric Turbidity Units (NTU) with a turbidity meter, and dissolved oxygen (DO) with a DO meter. Temperature was measured with a combination temperature/pH/conductivity meter.

## **2.2 Results and Interpretation**

### **2.2.1 Site Hydrostratigraphy**

The general site hydrostratigraphy is described in detail in reports by BBL (1993) and Hydrosystems (1989). Ground water at the Carteret Impoundments is contained within two distinct aquifers: an unconfined shallow aquifer of permeable fill materials and tidal marsh deposits and the confined Brunswick Formation shallow bedrock aquifer. Separating these two aquifers is a continuous layer of red-brown clay. The clay layer identified beneath the shallow unconsolidated material functions as a confining unit for the underlying Brunswick Formation (Hydrosystems, 1989).



As such, the clay layer will restrict the vertical flow of water between the shallow and bedrock aquifers.

In 1987, Cyanamid installed five paired monitoring well clusters to monitor the shallow unconsolidated and bedrock aquifers in accordance with requirements of their NJPDES/DGW permit. The shallow monitoring wells were screened from depths of 10 to 20 feet in the shallow fill material and tidal marsh deposits. The deep wells were screened in the upper weathered portion of the Brunswick Formation at depths ranging from 40 to 60 feet below ground surface (bgs).

In general, the stratigraphic conditions encountered during the installation of the new wells (clusters CRT-6, CRT-7, and CRT-8) are consistent with those observed during previous investigations (Hydrosystems, 1989). The site stratigraphy is summarized in Table 2-1 and illustrated graphically in Figure 2-2, which is a fence diagram based on well clusters CRT-2 through CRT-8. The general stratigraphy encountered in the new wells, in order of increasing depth below ground surface, is as follows:

- Fill Material - red-brown silt and gravel, with some debris (glass, wood, and concrete).
- Tidal Marsh Deposits - two distinct units; an upper peat unit, consisting of dark grey, silty clay with varying amounts of orange-brown peat; and a lower unit, consisting solely of dark grey silty clay.
- Red-Brown Clay Unit - red-brown clay, silt, and fine to coarse sand with a trace of fine rounded gravel.

- Weathered Bedrock - red-brown, grey, or light green clay with some interspersed pieces of unweathered siltstone.
- Shallow Bedrock - red-brown, light grey, and green siltstone.

As illustrated in Figure 2-2, some stratigraphic variations were observed at the CRT-8 cluster. Specifically, the tidal marsh deposits at this location consist solely of an upper peat unit (i.e., the lower unit is absent), and no significant thickness of weathered bedrock was encountered at this location.

Two rounds of water level measurements, one each at approximate low and high tides, were obtained on July 13 and July 14, 1994, respectively. These data are listed in Table 2-2 and are posted on Figures 2-3 and 2-4. These data support the existing conceptual ground-water model for this site [see BBL (1993) and Hydrosystems (1989)].

Assessment of the existing ground-water flow system is frustrated by data gaps, particularly as to the effect of tidal fluctuations on vertical and horizontal flow gradients. Although ground-water-to-surface-water discharge can be inferred from existing ground-water elevation data, this relationship is difficult to quantify without contemporaneous surface water elevation data for the Rahway River, Cross Creek, and Deep Creek. The ground-water/surface water discharge relationship for the southeast portion of the site is unknown because physical inaccessibility inhibits monitoring well installation along the Rahway River shoreline in this area. Data on the type and orientation of fractures in the bedrock aquifer system are also limited, as is knowledge of general locations of fracture discharge zones.

Based on the existing information, the following generalizations were made concerning ground-water flow patterns at the site. Ground water

originating as infiltration into the Carteret Impoundments moves radially outward from the impoundments, ultimately discharging to the adjacent surface waters of the Rahway River, Cross Creek, and Deep Creek. The water table is encountered approximately 2 feet bgs in the shallow monitoring wells. Water table mounding occurs in the shallow aquifer beneath the impoundments, where ground-water elevation was measured as approximately 10 feet above mean sea level (Hydrosystems, 1989). The mounded ground water apparently is further isolated from the more saline regional ground water by a difference in density (Hydrosystems, 1989).

The Brunswick Formation typically has a low primary porosity because the rock is generally fine-grained, and where coarser-grained rock is present it is tightly cemented and has a high clay mineral content. Most of the ground-water storage and movement in the Brunswick Formation occurs either in bedding plane fractures or in secondary fractures (joint sets) formed by stress related to faulting following the deposition and lithification of the beds (USGS, 1968). Regional flow in the Brunswick Formation occurs vertically and laterally toward the northeast, with ultimate discharge to surface water bodies which, in the vicinity of the Carteret Impoundments, include the lower Rahway River, Arthur Kill, and, eventually, the Atlantic Ocean.

Hydrosystems (1989) estimated ground-water discharge to the Rahway River ranging between approximately 11,000 cubic feet per day (CFD) [82,280 gallons per day (GPD)] and 17,000 CFD (127,160 GPD). However, these estimates are the result of hydrologic budget calculations using regional, not site-specific, data. Estimates of shallow ground-water discharge to the Rahway River were made using the recently obtained ground-water elevation data presented in Table 2-2. Disko (1982) completed permeability tests on subsurface samples. Using data

presented in Disko (1982), a mean coefficient of permeability (k) for this fill and tidal marsh units was estimated. The specific sample locations and the corresponding data used for this calculation are presented in Appendix A.

The mean k value derived from these data is 1.10 ft/day. This information, in conjunction with estimates of hydraulic gradients and aquifer porosity, can be used to calculate pore water velocities according to Darcy's law:

$$v = K(dh/dl)/n$$

where:

v = velocity (ft/day)

K = hydraulic conductivity (1.10 ft/day, see Appendix A)

dh/dl = hydraulic gradient ( $1.46 \times 10^{-3}$ , see Appendix A)

n = percent porosity (0.20, see Hydrosystems, 1989)

A summary of the resulting mean ground-water flow velocity calculation derived from both high and low tide data for the shallow aquifer is presented in Table 2-3. These data yield a mean ground-water flow velocity of  $7.97 \times 10^{-3}$  ft/day for the shallow aquifer.

Using a mean ground-water flow velocity of  $7.97 \times 10^{-3}$  ft/day for the shallow aquifer and assuming that all ground water in the shallow aquifer discharges to the Rahway River, a daily ground-water discharge volume ( $Q_d$ ) was estimated. The details of this estimation are presented in Appendix A. The estimation procedures are summarized below.

- Total ground-water discharge along line A-B (Figures 2-3 and 2-4) was estimated. This line was chosen because the existing

hydrostratigraphic control is optimal in this area. The estimation was made by:

- Determining the total shallow aquifer saturated thickness area along line A-B (i.e., the area of the vertical plane formed by the top of the water table and the top of the red-brown clay unit along line A-B). The resulting value is 18,070 ft<sup>2</sup>.
- Multiplying this value by the mean ground-water flow velocity for the shallow aquifer ( $7.97 \times 10^{-3}$  ft/day). The total discharge through this saturated thickness area is 1,077 GPD.
- Dividing this value by the total distance between points A and B (925 feet, see Figures 2-3 and 2-4) results in a discharge per linear foot ( $Q_{ll}$ ) of 1.16 GPD/ft.
- Extrapolating this value for  $Q_{ll}$  along the entire Rahway River shoreline adjacent to the impoundments (line A-B-C-D, 5,518 feet) (see Figures 2-3 and 2-4) results in a minimum total discharge estimate ( $Q_e$ ) of 6,424 GPD.

The estimate of 6,424 GPD is believed to be a minimum value because previous reports (Hydrosystems, 1989) indicate that ground-water mounding is greatest within the peninsula between well cluster CRT-3 and CRT-4. However, the effect of this mound has not been identified. If it is assumed that the hydraulic gradients in the mounded area are roughly twice that of the adjacent area (i.e.,  $2.92 \times 10^{-3}$  as opposed to

$1.46 \times 10^{-3}$ ) then the resulting value for  $Q_{II}$  along the shoreline segment C-D (see Figures 2-3 and 2-4) is 3.02 GPD/ft (see Appendix A for calculation details). Using a shoreline segment length of 2,166 feet for the shoreline discharge line C-D results in a total discharge along this line segment of 6,541 GPD (see Appendix A for calculation details). Accordingly, the discharge for the remainder of the shoreline would be:

$$1.16 \text{ GPD/ft} \times 3,352 \text{ ft} = 3,888 \text{ GPD.}$$

The estimated maximum discharge along the shoreline ( $Q_o$ ) is:

$$3,888 \text{ GPD} + 6,541 \text{ GPD} = 10,429 \text{ GPD.}$$

The accuracy of these estimates is uncertain. In particular, both the minimum and the maximum estimates for  $Q_o$  assume that discharge to the Rahway River from the bedrock aquifer is negligible because the red-brown clay unit is continuous throughout the area. However, the extent of the red-brown clay unit beneath the Rahway River has not been determined, and bedrock ground-water discharge cannot be reasonably estimated with the existing data. Furthermore, the K values derived from the permeameter tests were developed for the vertical orientation ( $K_v$ ). K values for the horizontal orientation ( $K_h$ ) are generally higher than  $K_v$ . For these reasons, the estimates for both minimum and maximum  $Q_o$  may be biased low.

### 2.2.2 Analytical Data Package Review

As requested by the NJDEP and outlined in the RAP, this section presents an interpretation of the analytical results obtained for the ground-water and surface water samples collected in the Supplemental Field Investigation. This evaluation ensures that the reported analytical results are evaluated for technical accuracy, integrated with historical information, and compared with surface water quality standards and ground-water quality criteria. Class II-A ground-water quality criteria are used for

comparative purposes because III-B criteria are developed on a case-by-case basis and are not available in the regulations.

All analytical results reported by IEA Laboratory follow NJDEP reduced data package deliverables. Data package deliverables are provided in a separate document accompanying the report and include TCL VOCs, TAL inorganics (dissolved and total metals), plus total and free cyanide, sulfate, chloride, and TDS. Appendix D presents a data validation review of IEA's data package deliverables. Table 2-4 summarizes the analyses performed on surface water and ground-water samples.

In environmental analysis, sample media can be more complex than expected, or can contain interfering materials whose presence can not be predicted with both precision and accuracy. These common issues are typically assessed through collection and analysis of quality assurance/quality control (QA/QC) samples. The interpretation of analytical results begins with a review of QA/QC samples and data qualifiers. Following is a discussion of several sample collection and laboratory analysis issues affecting the analytical results interpretation for the supplemental investigation. QA/QC sample results are summarized in Table 2-5.

Analytical results for the samples collected between July 13 and 15, 1994 did not reveal any problems associated with the testing for organics. However, there were a number of complications associated with the metals analyses, most of which related to detections in the field blanks.

Blanks are a type of QA/QC sample used to evaluate possible introduction of contaminants during sample collection, transport, and laboratory analysis. Results from blank samples are useful in assessing the extent of bias in the event that contamination is detected in media samples. For the supplemental field investigation, trip blanks and field

blanks were included to assess whether contaminants were introduced during sample collection or transport.

Results for the blank analyses indicate the presence of acetone in a trip blank and a field blank associated with the surface water samples. This solvent is commonly used in the decontamination of sampling and laboratory equipment, sample preservation, and sample extraction in the laboratory. Since acetone was not detected in any of the surface water samples collected, its presence in the blanks is likely due to laboratory or field sampling procedures.

The results for the trace metals analyses of the blank samples are important because they indicate the results for ground water and surface water samples are probably affected by contamination in the blanks. In other words, the results indicate that the concentrations of aluminum [dissolved (d)], arsenic [total and dissolved (t & d)], beryllium (d), calcium (d), chromium (d), copper (d), iron (t & d), lead (d), magnesium (d), manganese (d), mercury (t), nickel (t), potassium (d), sodium (t & d), thallium (t), and zinc (t & d) reported by the laboratory may be greater than the actual concentrations naturally occurring in the water because contamination similar to that found in the blanks is present in the water samples. The influence of these blank sample results on the data interpretation is discussed in the following sections.

### 2.2.3 Ground-Water Quality

Ground-water chemistry at the Carteret Impoundments is comparable to the common salt and ion chemistry characteristic of saline waters such as the tidal Rahway River and Arthur Kill. Several inorganic constituents characteristic of saline water are also common to the inorganic composition of the alum and YPS production residue contained in the impoundments.



Organic compounds have been virtually non-detectable in ground-water samples collected downgradient of the impoundments. Because shallow ground water is naturally unsuitable for potable supply, the results for inorganic analyses are compared to a range of ground-water quality results obtained for background monitoring wells CRT-1 and CRT-8.

Beginning in July 1987, Cytec evaluated ground-water quality by sampling 10 on-site monitoring wells on a quarterly basis. Organic compounds were analyzed for semi-annually. After 22 quarters of sampling and analysis, this monitoring program was ceased in 1992 when NJPDES/DGW permit No. NJ0061611 was withdrawn. Complete analytical laboratory deliverables have been submitted previously to the NJDEP (see Appendix E of the RIWP). Following is a discussion of the monitoring data collected at the 10 existing on-site monitoring wells and the six newly installed monitoring wells in July 1994, data which are considered representative of current ground-water quality in the shallow and bedrock aquifers.

#### SHALLOW AQUIFER

Table 2-6 summarizes analytical results for the shallow ground-water sampling performed in July 1994.

Analytical results for organic analyses of shallow ground-water samples corroborate the absence of organic compounds in the residues impounded at Carteret. The results for monitoring wells CRT-2S, CRT-3S, CRT-4S, CRT-5S, CRT-6S, CRT-7S, and CRT-8S demonstrate no consistent detections of organic compounds.

Organic compounds have been consistently detected in monitoring well CRT-1S, located upgradient of the Carteret Impoundments. Prior to installation of monitoring well pair CRT-1, Cytec demanded the removal of

various refuse that had been improperly placed on its property by operators of an industrial salvage yard located immediately west of the Carteret Impoundments. Comparison of the 1994 data with historical results (Table 2-7) indicates decreasing concentrations of benzene and toluene in monitoring well CRT-1S. The organic compounds detected in samples from monitoring well CRT-1S most likely originate from the upgradient property. Organic wastes were never deposited in the Carteret Impoundments.

Potential changes in ground-water quality resulting from leaching of the inorganic residues contained in the Carteret Impoundments would include constituents used in alum and YPS production: aluminum, calcium, sodium, iron, cyanide, carbonate, and sulfate. It is noteworthy that the majority of these inorganic constituents also occur naturally in the bedrock of the Brunswick Formation and the saline waters of the Arthur Kill and Rahway River.

Chloride, sulfate, and TDS were detected in all of the shallow ground-water samples. The presence of these contaminants is likely attributable to the influx of saline water from the Rahway River. This is substantiated by the relatively elevated concentrations of these contaminants in samples taken from those monitoring wells located closest to the Rahway River.

Total cyanide concentrations were detected above background in all eight shallow monitoring wells at maximum concentrations exceeding the Class II-A GWQC. Free cyanide was detected in six of the eight shallow ground water samples. A review of historical data reveals a significant decrease in total cyanide concentrations at three of the five wells (CRT-2S, CRT-3S, and CRT-5S), and no significant change in free cyanide. In fact, free cyanide represents less than 2 percent of the maximum total cyanide concentration which was detected in monitoring well CRT-4S.

The absence of free cyanide is a function of the chemical form of cyanide in the residue, physical and chemical characteristics of the residue, and behavior of cyanide in mineral-rich water. In mineralized water, such as the on-site shallow ground water, cyanide occurs predominantly as complexes with ligands and metals.

Complex formation shifts the equilibrium from free cyanide to cyanide complexes when metal ions and ligands are available to remove free cyanide from solution, incorporating it into a complex (Snoeyink and Jenkins, 1980). Substantially lower iron concentrations detected in the downgradient monitoring wells in both historical and current sampling events suggest that relatively insoluble iron cyanide complexes predominate in the total cyanide detected in shallow ground water. In fact, the lowest iron concentrations were reported in the sample with the highest cyanide contents, CRT-4S.

The ferrocyanide complex produced in YPS production and the absence of free cyanide in ground-water samples corroborate the presence of insoluble iron cyanide complexes. Unlike easily decomposed, water-soluble metal cyanide, insoluble metal cyanide, such as ferric and ferro cyanide, are not expected to degrade to free cyanide.

All other inorganic contaminants detected in Monitoring Wells CRT-2S, CRT-3S, CRT-4S, CRT-5S, CRT-6S, and CRT-7S were reported as below detection limits or comparable to concentrations reported in background monitoring wells CRT-1S and CRT-8S.

### Bedrock Aquifer

As described in more detail in Section 2.2.1, the Bedrock Aquifer is overlain by a silty clay weathered bedrock unit of variable thickness, which represents a low conductivity water bearing unit (confining unit) between the overburden aquifer units and the bedrock aquifer. The five monitoring wells designated CRT-1D to CRT-5D, which were installed by Testwell Craig, have open intervals across both the weathered bedrock confining unit and the unfractured uppermost 10 feet of the competent bedrock. The three monitoring wells designated CRT-6D to CRT-8D, which were installed in 1994 by Blasland, Bouck & Lee, are screened solely in the competent bedrock. Because of this distinction, the two groups of wells will be discussed in two separate sections: competent bedrock unit and weathered bedrock confining unit. Table 2-9 provides a comprehensive summary of all the analytical results for the deep ground-water monitoring wells sampled in July 1994.

### Competent Bedrock

Monitoring wells CRT-6D, CRT-7D, and CRT-8D were all screened in the competent bedrock unit. Organic compounds were virtually non-detectable in ground-water samples collected from all three of these wells, although acetone was detected at low ppb concentrations. However, because acetone is a common laboratory contaminant, these trace level concentrations are likely due to laboratory contamination. Similar to shallow ground water, samples of deep competent bedrock ground water show the influence of salt water influx. Sodium, chloride, and TDS concentrations were elevated in all three monitoring wells. Total cyanide concentrations were comparable to or less than those measured in shallow ground water.

### Weathered Bedrock Confining Unit

Monitoring wells CRT-1D to CRT-3D are screened across both the Weathered Bedrock Confining Unit and the unfractured uppermost 10 feet of competent bedrock. The method used to construct these wells is considered questionable. Unlike the recent well constructions, the construction record for the older "Test Well Craig" wells indicates that these wells were installed through hollow-stem augers. Since at least one confining unit was breached by these boreholes, it is suggested that this method of construction is inconsistent with current NJDEP monitoring well requirements.

To accomplish these well constructions, a continuous borehole was advanced from grade, through the overburden units (including fill units) into the top of the weathered bedrock. (Neither the presence of water-bearing bedrock fracture zones nor the source of bedrock ground-water are noted on the logs for these wells). As has been shown, only a relatively thin zone of weathered bedrock overlies the well sand pack. Site experience suggests that, though composed of silty clay, this unit frequently maintains a relic shale texture. Imposing a significant drawdown in the well (as would be caused when the well was purged prior to sampling) could induce ground-water flow from among the unconsolidated units and the weathered bedrock unit along the outside of the borehole, into the well. As a result, fine-grained materials from the weathered bedrock unit, which could likely be bound to contaminants of anthropogenic origin, are likely being mobilized and mistakenly recognized as ground-water anomalies within the bedrock aquifer. In reality, given the extremely low transmissivity associated with this confining unit, even high levels of observed ground-water contaminants found in this interval

represent a trivial mass of contamination actually available for subsurface transport.

A comparison of recent and historical ground-water quality data for weathered bedrock monitoring well CRT-4D reveals an apparent increase in total cyanide concentration over time. This increase is most likely attributable to two factors: the aforementioned inappropriate well construction and a two-year interval between the most recent and the previous sampling event.

Table 2-8 provides a statistical summary of ground-water quality data collected on a quarterly basis during 1991 and 1992. Comparisons to the July 1994 sampling event suggest that total cyanide concentrations have remained the same or decreased in the five wells sampled. The regular sampling and purging of a well results in conditions wherein the well, the surrounding sand filter pack, and the formation in the immediate vicinity of the well are regularly flushed free of fine silt and clay particles. However, because CRT-4D was not sampled for approximately two years prior to July 1994, suspended solids and fine clay and silt particles would likely have accumulated in and around the well.

Further, the weathered bedrock unit consists of fine clay particles which would be impossible to filter out with a conventional sand filter pack. This influx of clay particles would result in higher turbidity in ground water obtained from this well versus wells screened solely within the competent shallow bedrock unit.

Field notes from the July, 1994 sampling event reveal that three complete well volumes were purged and that the field parameters (temperature, pH and conductivity) had generally stabilized prior to sampling. However, at the end of the purging activities and during the actual sampling activities, the water turbidity was described as moderate

and the water color was described as black. The moderate turbidity is indicative of relatively high concentrations of fine suspended particles (clays) and the black color is indicative of organic materials. Cyanide complexes commonly adhere to fine particles, organic complexes, and ligands.

Therefore, the increase in total cyanide concentration is most likely attributable to the moderate turbidity of the sample, which is related to the inferior quality of the well construction (including its open interval within the Weathered Bedrock Confining Unit) and to the length of time between sampling events. These factors allowed cyanide complexes, which normally would be bound up in the weathered bedrock clay matrix, to flow into the well. The relatively elevated concentration of total cyanide detected in the July 1994 sampling event is an anomaly and is not indicative of any significant trend in either overburden or bedrock aquifer quality.

Similar to shallow ground water, the lowest iron concentration is reported in the sample with the highest total cyanide concentrations: monitoring well CRT-4D. Substantially lower iron concentrations detected in the downgradient monitoring wells suggest that relatively insoluble iron cyanide complexes predominate.

No other inorganic constituents in the deep monitoring well samples were elevated relative to the background samples from monitoring well CRT-8D.

#### 2.2.4 Surface Water Quality - Deep Creek

As discussed previously, surface water samples were collected instead of ground-water samples at locations adjacent to Impoundment 1 due to its physical inaccessibility. Results from surface water sample analyses for several conventional quality parameters (VOCs, cyanide, and trace

metals) are discussed in the following sections and summarized in Table 2-10. Historical surface water sampling data from Deep Creek are not available for comparison to the recent sampling analyses.

Conventional water quality analyses at all three sampling locations (SW-1, SW-2, and SW-3) indicate that concentrations of chloride, sulfate, and TDS progressively increase in the direction of the confluence of Deep Creek with the Rahway River. The presence of these constituents is most likely attributable to the influx of saline water from the tidal Rahway River.

VOCs were not detected in any of the surface water samples collected and analyzed. Total cyanide was detected in samples from two of three locations, those for SW-1 and SW-2. Free cyanide was only detected in the sample from the most upstream location, SW-2. Neither total nor free cyanide were detected in the sample from the downstream location, SW-3.

Unfiltered and filtered surface water samples were collected from the three locations to identify total and dissolved (bioavailable) concentrations for 23 trace metals. Bioavailability and toxicity vary with the form of the metal. Particulate metals are generally expected to have less bioavailability than dissolved metal (USEPA 1992). Both total and dissolved metals are compared to the SE3 SWQC values, although it is reasonable that total metals concentrations exaggerate actual bioavailability. Furthermore, the NJDEP has only promulgated SE3 SWQC for five of the 23 trace metals analyzed for in the surface water, and these SWQC are for the protection of human health.

Cadmium, cobalt, mercury, nickel, selenium, silver, and vanadium were not detected in surface water samples. Beryllium was detected in total sample SW-2. Lead was detected in total sample SW-1. Antimony was detected in two total metals analyses and none of the dissolved metals analyses. Arsenic was not detected in any total metals analyses and in



two of the dissolved metals analyses. The absence of correlation between the total and dissolved arsenic analyses introduces some uncertainty regarding these results.

The remaining trace metals analyzed for, aluminum, barium, calcium, iron, magnesium, potassium, and sodium, were detected in all of the total and dissolved samples. These trace metals were also, with the exception of barium, detected in the QA/QC field blanks. Total and dissolved concentrations of manganese occur at concentrations that exceed the surface water criterion for human health.

Although total and dissolved concentrations of manganese exceed the criterion for human health, consideration must be given to the following influential factors:

- manganese concentrations in the two surface water samples from Deep Creek that exceed the SWQS (SW-1 and SW-2) are qualified with an "E". This qualification signifies that the reported value is estimated and suggests the possibility that the value is biased high.
- the exceedances detected in the two isolated surface water samples are in the same order of magnitude as the SWQS for manganese, and only exceed by the standard by less than 0.05 ppm.
- manganese concentrations detected in background shallow groundwater monitoring wells are greater than those detected in perimeter wells downgradient of the impoundments. This suggests that the presence of manganese in surface water is likely

attributable to sources other than the residue contained in the impoundments. It should be noted that manganese is ubiquitous in the environment, with releases occurring from natural sources, such as manganese nodules, and from processes such as fossil fuel combustion waste incineration, or cement production (USDHH, 1991; Raiswell et. al 1980).

- the human health criterion of 0.1 ug/l was developed by USEPA in 1976 to protect against a possible health hazard to humans by manganese accumulation in shellfish. USEPA assumed that manganese may concentrate in the edible portions of mollusks, although limited supporting data were available, in developing the human health criterion for manganese. Furthermore, because the presence of shellfish in Deep Creek is uncertain, and their consumption is considered highly improbable thus, exposure via this pathway is also considered unlikely.

## **SECTION 3 - III-B GROUND-WATER CLASSIFICATION AND ALTERNATE GROUND-WATER CRITERIA DEVELOPMENT**

### **3.1 Ground-Water Classification**

Ground water occurring in the shallow aquifer and in that portion of the Brunswick Formation underlying the Carteret Impoundments is not classifiable as potable water, owing to regional influence of saline waters from tidal surface water. The recently promulgated Ground Water Quality Criteria (NJAC. 7:9-6) presents a ground-water classification system that identifies three classes of ground water and their designated uses based on hydrogeology. The three classes of ground water adopted by NJDEP are:

- Class I - Ground Water of Special Ecological Significance
- Class II - Ground Water for Potable Water Supply
- Class III - Ground Water With Uses Other Than Potable Supply

Table 3-1 summarizes the hydrogeologic characteristics and designated uses outlined in NJAC. 7:9-6.5 for each of the three ground-water classes. These ground-water classification criteria (GWQC) have been evaluated against hydrogeologic data obtained for shallow zone and bedrock ground water to determine the appropriate ground-water class for each unit beneath the Carteret Impoundments. Following is a unit-by-unit discussion of ground water underlying the Carteret Impoundments, based on the NJDEP classification system.

### **3.2 Ground-Water Use**

Ground water in shallow fill material is non-potable, based on measurements of total dissolved solids (TDS) and chloride ion that exceed the

NJDEP Class II-A criteria for potable water. Cytec historically has collected and analyzed ground-water samples from five of the eight on-site wells that monitor the shallow unit: CRT-1S, CRT-2S, CRT-3S, CRT-4S, and CRT-5S. In 110 ground-water samples analyzed during 22 quarterly monitoring events from July 1987 through October 1992, TDS ranged from 7,800 to 29,800 mg/l, with an average of 20,229 mg/l; and chloride ion detections ranged from 67.6 to 18,300 mg/l, with an average of 10,472 mg/l. Ground-water samples collected in July 1994 from the five shallow wells listed above and the three new monitoring wells (CRT-6S, CRT-7S, and CRT-8S) also contained TDS and chloride concentrations greater than II-A Criteria (Table 2-6). These results are indicative of a Class III-B ground water; aquifers in which chloride exceeds 3,000 mg/l or TDS exceeds 5,000 mg/l (see Table 3-1). It is noteworthy that the greatest TDS and chloride levels were measured in samples from the monitoring wells closest to the Rahway River (i.e., CRT-3S, CRT-4S, CRT-5S, CRT-6S, and CRT-7S), indicating that tidal action influences shallow ground water by introducing more saline, non-potable river water into the shallow unit.

An 8-to-25-foot-thick red-brown clay separates the Brunswick Formation from the overlying shallow fill unit, functioning as an aquitard by effectively confining the underlying Brunswick Formation.

Ground water within the Brunswick Formation underlying the Carteret Impoundments is also non-potable, based on measurements of TDS and chloride ion that exceed the NJDEP Class II-A criteria for potable water. Ground water from the Brunswick Formation is enriched in sulfate, dissolved solids, and calcium, owing to the dissolution of gypsum and calcite from the formation (USGS, 1968). This formation apparently has a hydraulic connection with the Arthur Kill, whose water has a chloride ion concentration greater than 15,000 mg/l (USGS, 1968).

Cytec has historically collected and analyzed ground-water samples from four on-site wells that monitor the bedrock unit: CRT-1D, CRT-2D, CRT-3D, and CRT-4D. In 88 samples analyzed during 22 quarterly monitoring events from July 1987 through October 1992, TDS ranged from 2,600 to 27,100 mg/l, with an average of 21,048 mg/l; and chloride ion detections ranged from 1,510 to 16,380 mg/l (Table 3-2). Ground-water samples collected in July 1994 from the four monitoring wells listed above and from the three new bedrock monitoring wells (CRT-6D, CRT-7D, and CRT-8D) also contained TDS and chloride concentrations greater than II-A criteria (see Table 2-9). These results are indicative of a Class III-B ground water, and are apparently the result of salt water intrusion from the Rahway River and the Arthur Kill displacing fresh ground water.

Potential ground-water uses are limited by both the natural quality of the ground water and, to some extent, by past discharges to this area. The absence of ground-water use near the Carteret Impoundments follows a recommendation made by the USGS (1968) that, in order to avoid saltwater intrusion into the Brunswick aquifer in the Arthur Kill area, ground-water development should be limited to areas upgradient of the 20-foot mean sea level (msl) contour. The Carteret Impoundments are located within this contour. The saline conditions evident in the ground water suggest that it will continue to be unsuitable for potable use.

Ground water use in the vicinity of the Carteret impoundments is primarily restricted to industrial applications (e.g., non-contact cooling water). A survey of ground-water use indicates that there are currently no water supply wells located downgradient of the impoundments (Disko, 1982). This survey indicated that 18 wells were registered with the State of New Jersey within a 2-mile radius of the Carteret Impoundments and that all were located upgradient of the site. The survey stated that of these 18 wells, 12 are screened in the Brunswick Formation, and six are screened in the Raritan Formation. However, a review

of U.S. Geological Survey (USGS) maps indicates that the Raritan River Formation is not present in the Carteret area. An additional survey of ground-water use within a 1-mile radius of the Carteret Impoundments (July 1994) conducted by BBL revealed records for more than 500 monitoring wells. Table 3-3 provides a summary of records for wells other than monitoring wells located within a 1-mile radius of the site, all of which were found to be located upgradient of the site. It is noteworthy that the majority of these wells, with the exception of several recently installed ground-water treatment recovery wells, were installed more than 25 years ago and their continued existence is uncertain.

There are currently no present or future plans to locate any wells for potable use or any other purposes in this area (S. Szaranowski, Middlesex Water Company, personal communication, May 23, 1994). Although there are reportedly some wells located west of the Carteret Impoundments in North Edison, they are far removed from and hydraulically upgradient of the Carteret Impoundments. Residents of the Borough of Carteret are provided potable water by Middlesex Water Company (MWC). MWC obtains potable water for the Borough of Carteret from the Delaware/Raritan Canal.

### **3.3 Alternate Ground-Water Quality Criteria**

NJAC 7:9-6.7(f) specifies that GWQC for Class III-B ground water be determined on a case-by-case basis to ensure that there will be no:

- Impairment of existing uses of ground water;
- Resulting violation of Surface Water Quality Standards;
- Release of pollutants to the ground surface, structures, or air in concentrations that pose a threat to human health; or

- Violation of constituent standards for downgradient classification areas to which there is a significant potential for migration of ground-water pollutants.

As recommended in NJDEP's February 24, 1994 approval for the RIWP, site-specific III-B ground-water standards were developed to ensure that surface water quality standards are met where ground water discharges to surface water. This approach is consistent with NJAC 7:9-6.7(f) and (g) requirements for III-B GWQC.

The process used to develop III-B criteria was as follows:

- Identification of Potential Receptors (Section 3.3.1);
- Discussion of Potential Exposure Pathways (Section 3.3.2);
- Identification of Contaminants of Concern (Section 3.3.3);
- Development of III-B GWQC (Section 3.3.4); and
- Comparison of III-B GWQC to analytical data (Section 3.3.5).

#### 3.3.1 Identification of Potential Receptors

This section identifies and characterizes the potential human and environmental receptors which may come in contact with ground water affected by past operations at the Carteret Impoundments.

As discussed in Section 3.2, ground water occurring in the shallow and bedrock aquifers underlying the Carteret Impoundments demonstrates the characteristics of Class III-B defined in NJAC 7:9-6.5. The designated uses for Class III-B ground water consist of any reasonable uses for such ground water other than potable water, using water of existing quality. This designation and the absence of downgradient supply wells excludes local residents as receptors through domestic use.

Ground-water flow direction influences the potential receptors for ground water within the shallow unit and the bedrock. The majority of ground water beneath the Carteret Impoundments discharges to surface water bodies, including the Arthur Kill and Rahway River and, to a lesser extent, Cross Creek and Deep Creek. Therefore, these surface water bodies are the most likely receptors for contaminants of concern associated with ground water.

The Rahway River flows along the north and east boundaries of the Carteret Impoundments after draining a watershed of approximately 41 square miles in northeast New Jersey. This area of New Jersey is heavily developed, with the centers of population being Rahway, Woodbridge, Clark, Springfield, Cranford, Westfield, and Kenilworth. Land use in the Rahway River watershed is predominantly residential, commercial, and industrial.

The main stem of the Rahway River, 24 miles long, flows from Union, New Jersey into the Arthur Kill at a point less than 1 mile from the site. It is tidal from the Pennsylvania Railroad Bridge at Rahway down to the confluence with the Arthur Kill (approximately 5 miles). Major tributaries to the Rahway River include the east branch of the Rahway River, the Woodbridge River, and Robinsons Branch. Lesser tributaries include two tidal creeks which receive drainage from the Carteret Impoundments: Cross Creek and Deep Creek.

From the crossing at Routes 1 and 9 in Carteret, New Jersey to its confluence with the Arthur Kill, the Rahway River and its tidal tributaries are classified by the NJDEP as SE3 waterbodies (NJAC 7:9-4.15). The designated uses of Class SE3 waterbodies are as follows:



- secondary contact recreation (boating and fishing);
- maintenance and migration of fish populations;
- migration of diadromous fish;
- maintenance of wildlife; and
- any other reasonable uses.

The tidal portions of the Rahway River which form the eastern and northern site boundaries are a component of the Hudson-Raritan Estuary. The entire shoreline and neighboring inland areas outlining the Hudson-Raritan Estuary have been extensively developed. As a result of this development, natural habitats have been heavily urbanized.

Biological resources in the Hudson-Raritan Estuary have undoubtedly been influenced by the extensive development of the estuary, its shoreline, and neighboring inland areas that has occurred during the past 150 years. Overfishing, habitat alteration, and changes in water quality have affected major fisheries such as shad, smelt, blue crabs, and oysters that existed in the estuary during the 19th century (NOAA, 1982). Physical development of the shoreline area has eliminated small coves and bays which had served as fish breeding and development areas. Biological resources in the Rahway River are characterized by the New Jersey Division of Fish, Game, and Wildlife as those of a moderately degraded warm-water fishery. The species composition information presented below is relevant to SE3 portion of the Rahway River near the Carteret Impoundments.

Phytoplankton and zooplankton composition and abundance patterns in the Hudson-Raritan estuary follow those expected for typical estuaries in eastern North America (NOAA, 1982). Dominant phytoplankton vary according to season, consisting of diatoms during the winter and

nannoplankton in the summer. Zooplankton within the Arthur Kill are dominated by calanoid copepod species, particularly polychaete worms (NOAA, 1982).

Recent benthic invertebrate sampling in the Arthur Kill identified four species of bivalves (hard- and soft-shelled clams, blue mussel, and ribbed mussel). Most of the bivalves collected were gathered from the high intertidal zone; few individuals were found in the medium intertidal, low intertidal, or subtidal zones (Louis Berger & Assoc., 1991). Pollution from discharge of human sewage and siltation from the dredging of shipping canals are the primary contributors to the decline of commercially important benthic shellfisheries, namely hard- and soft-shell clams, and oysters (NOAA, 1982). Physical changes in benthic habitat to accommodate shipping are also considered responsible for the absence of blue crabs from the Arthur Kill (USEPA, 1987).

Fish species composition is comparable to a typical middle-Atlantic estuary, except for the paucity of benthic-feeding species relative to similar estuaries (NOAA, 1982). Fish species collected by the U.S. Fish and Wildlife Service (USEPA, 1987) in the northern Arthur Kill and southern Newark Bay between July and December 1984 are presented in Table 3-4. From the USFWS effort and previous sampling performed in the early 1970s (NOAA, 1982), the mummichog was identified as the most abundant fish species. Data from the early 1970s indicate that the mummichog, blueback herring, goldfish, and bay anchovy accounted for approximately 90 percent of the fish collected (NOAA, 1982). Migratory (anadromous) fish such as the alewife, American shad, American eel, and blueback herring were present during the winter months (NOAA, 1982).

### 3.3.2 Discussion of Potential Exposure Pathways

#### Ground Water

Potential exposure pathways for ground water involve discharge to surface water because, as discussed previously, potable use is neither a realistic nor anticipated use for ground water beneath the Carteret impoundments. Residents of the Borough of Carteret are provided potable water by MWC, which uses the Delaware and Raritan Canal as a water source. Thus, exposure via the residential pathway (i.e., ground-water ingestion) is unlikely.

#### Surface Water

NJDEP's designated uses for the SE3 Rahway River and the Arthur Kill limit potential receptors to individuals involved in secondary contact recreation or to aquatic or semi-aquatic organisms. Secondary contact recreation includes those activities, such as boating or fishing, where the probability of water ingestion is minimal (NJAC 7:9-4.1). Potential exposures which could occur include inhalation of volatile emissions or aerosols during secondary contact recreation, and ingestion of edible fish or shellfish tissue which has bioaccumulated contaminants of concern.

Volatile emissions would be minimal due to the infrequent detection of low concentrations of VOCs detected in ground water samples from one of eight pairs of on-site monitoring wells and the large extent of ground-water dilution occurring in surface water. Additionally, the air mixing conditions prevailing over the Hudson-Raritan Estuary would rapidly reduce concentrations (NOAA, 1984). All of these factors would effectively mitigate potential inhalation exposure concentrations.

Although bioaccumulation is a potential exposure pathway, it is not believed to be significant for several reasons: first, because the

consumption of certain fish or shellfish caught in the Hudson-Raritan Estuary is restricted by NJDEP (NJAC 7:25-18A), although the effectiveness of this restriction is uncertain; and, second, most of the inorganic contaminants of concern detected in the ground water have not been demonstrated to either bioconcentrate or biomagnify in the aquatic or terrestrial food chain. Therefore, exposure via bioaccumulation, in the unlikely event of consumption of fish or shellfish, is not considered an important pathway. However, the development of III-B criteria considers this pathway to ensure protection of human health and the environment:

### 3.3.3 Identification of Contaminants of Concern

Volatile and inorganic constituents were detected in ground-water samples collected from the shallow and bedrock aquifers underlying the Carteret Impoundments. Many of these contaminants were not detected at or above published regulatory criteria that trigger concern for human health or the environment. To focus the III-B criteria development process, a subset of the detected constituents was selected as contaminants of concern.

The process of selecting contaminants of concern requires execution of a series of steps. First, an initial list of all the contaminants detected in shallow and bedrock ground water was compiled from the July 1994 sampling effort. Tables 3-5 and 3-6 provide a summary of all the contaminants detected in the shallow and bedrock ground water, respectively, the maximum concentrations at which they occur, and the Class II-A GWQC and Class SE3 surface water quality standards (SWQS). Next, the maximum concentration for each detected constituent was compared to its Class II-A GWQC and SWQS. Those contaminants which

exceed either a GWQC or SWQS were selected as contaminants of concern.

Prior to discussing the results of the comparison of ground-water quality data to GWQC and SWQS, it is important to emphasize the intent of the criteria used in the evaluation and their relevance to ground water underlying the Carteret Impoundments.

Class II-A GWQC were developed for the protection of Class II-A potable water supply aquifers. These criteria are deemed protective of human health over a 70-year lifetime at a water consumption rate of 2 liters per day. As described in Section 3.1, attainment of II-A GWQC in the shallow and bedrock aquifers underlying the Carteret Impoundments is inappropriate because neither aquifer provides water which naturally meets potability requirements for TDS or chloride ion, and there are no plans for future potable use. Although both aquifers are unsuitable for drinking water because of natural salt water intrusion, II-A GWQC were used conservatively to select contaminants of concern.

SWQS were developed to maintain designated uses for surface water, including protection of resident aquatic organisms and human health. SWQS for SE3 surface waters include human health criteria based on routine consumption of fish and shellfish which have accumulated contaminants of concern in edible tissue. However, NJDEP has placed restrictions on the consumption of fish and shellfish caught in the tidal reach of the Rahway River, although the effectiveness of this restriction is uncertain, SWQS protective of human health were used conservatively to select contaminants of concern. Furthermore, direct comparison of ground-water data from monitoring wells to SWQS excludes the reasonably expected attenuation that will occur when ground-water discharges to

surface water. Table 3-7 summarizes those contaminants found to exceed either the Class II-A GWQC or SE3 SWQS.

#### 3.3.4 Development of III-B Ground Water Criteria

The following section presents the methodology used to develop III-B GWQC. Alternate shallow and bedrock zone ground-water standards were back-calculated from appropriate NJDEP surface water criteria for the SE3 Rahway River. A straightforward mass balance approach was taken to estimate the relationship between contaminants of concern detected in on-site ground-water samples from the shallow and bedrock units and the potential impacts to surface water quality. The approach followed three steps:

1. Identifying target concentrations of contaminants of concern in surface water which are protective of the Class SE3 designated uses for the pertinent reaches of the Rahway River.
2. Calculating a dilution factor to represent the expected decrease in on-site ground-water contaminant of concern concentrations following discharge to surface water. Dilution in surface water is estimated as a function of the ground-water discharge rate and the flow rate in the tidal Rahway River.
3. Back-calculating alternate ground-water concentrations by multiplying the target surface water concentration by the dilution factor.

Salt water criteria for protection of aquatic life in the Arthur Kill and Rahway River were selected from the SWQS for SE3 waters and USEPA's Quality Criteria for Water established pursuant to the Clean Water Act. If a regulatory criterion was not identified in these sources, then toxicity

values presented in the literature were reviewed. The process used to identify these criteria follows.

Criteria for protection of aquatic life focus on population (or species) endpoints that have been measured using single-species toxicity testing. These endpoints include both acute measures of lethality and chronic (or sublethal) evaluations of developmental, reproductive, and behavioral effects. Criteria used in III-B GWQC development are equivalent to acute or chronic water quality criteria developed by NJDEP or USEPA. If water quality criteria were not available for a particular contaminant, then a no-observed-effect level (NOEL) or lowest-observed-effect level (LOEL) reported in the literature was lessened by an uncertainty factor (UF). These UFs were based on the ranges of uncertainty for aquatic toxicity data extrapolation described by USEPA (1991). The UF concept is similar to that historically used for extrapolation of animal data to ensure protection of humans. A UF may be applied to account for uncertainties related to variation in sensitivity between species, extrapolation from acute to chronic exposure durations, and field and laboratory differences (USEPA 1987). UF applied in this process were as follows:

- UF of 10 when test species differ from resident species for the Rahway River;
- UF of 10 when a LOEL was used because a NOEL was not available; and
- UF of 10 when acute data were used to extrapolate to a chronic benchmark.

Water quality criteria for the protection of human health from long-term consumption of fish and shellfish from the Rahway River were also

considered, although NJDEP has imposed a restriction on fish and shellfish consumption. Surface water quality criteria for the protection of human health assuming the long-term consumption of fish and shellfish from the Rahway River were either selected from available water quality criteria (WQC) provided by USEPA (1986) under the purview of the Clean Water Act or calculated using standard exposure assumptions and agency-approved toxicity indices. The WQC for the protection of human health are established by USEPA (1980; 1986) assuming the bioconcentration of constituents in edible tissue of fish/shellfish and the subsequent ingestion of 6.5 grams of affected tissue per day over a 70-year lifetime.

WQC have not been promulgated for some of the contaminants of concern detected in on-site ground water, particularly those ions which are common salts (e.g., sodium) present in saline waters as well as required for osmotic regulation. Therefore, target objectives which are protective of tissue ingestion were not developed for all contaminants of concern. The more stringent of either the aquatic life criterion or human health criterion was selected to develop III-B GWQC that would not produce an exceedance of the more stringent criterion in the Rahway River.

Choosing protective surface water criteria for the Rahway River and the Arthur Kill depends on contaminant of concern toxicity and the receptors to be protected. Shellfish and pelagic fish from the Arthur Kill have been sampled historically by federal agencies. Siltation from dredging of the shipping channel and discharge of sewage reportedly have led to decline in the abundance of shellfish (NOAA, 1982). The most abundant fish species reported in these sampling efforts were the mummichog (*Fundulus heteroclitus*), blueback herring (*Alosa pseudoharengus*), goldfish (*Carrius auratus*), and bay anchovy (*Anchoa mitchilli*). These species, which accounted for more than 90 percent of the fish collected (NOAA, 1982),



are considered in the development of surface water criteria. Ecotoxicity data for each ground-water contaminant of concern are summarized in Table 3-8.

#### Evaluation of Ground-Water Discharge to Rahway River

The potential impacts of ground-water discharge to the Rahway River were evaluated based on dilution. Dilution is a function of the ground-water discharge rate and surface water flow rate. The ground-water discharge rate is calculated using Darcy's Law. Expected dilution was calculated in terms of tidal exchange estimates, and a range of dilutions was developed for the Rahway River.

The average theoretical ground-water discharge rates from the shallow fill and bedrock zone into the Rahway River were calculated as follows:

$$Q = K \times i \times W \times D \text{ (Equation 1)}$$

where:

Q = flow rate (ft<sup>3</sup>/sec)

K = hydraulic conductivity (ft/sec)

i = hydraulic gradient (ft/ft)

W = width of discharge area (ft)

D = depth of discharge area (ft)

The input parameters and the mean theoretical ground-water discharge rates predicted with Equation 1 will be presented. The mean theoretical discharge rates will be presented as follows:

	<u>Shallow Fill</u>	<u>Bedrock</u>	<u>Combined</u>
• Rahway River ft <sup>3</sup> /sec	0.01 to 0.02	Not qualified	0.01 to 0.02

Expected dilution is calculated in terms of tidal exchange estimates. Fischer et al (1979) define dilution discharge as follows:

$$Q_d = Q_o + Q_g + Q_i \quad (\text{Equation 2})$$

where:

$Q_d$  = the dilution discharge (ft<sup>3</sup>/sec)

$Q_o$  = the circulating flow of ocean water from outside the boundary  
(ft<sup>3</sup>/sec)

$Q_g$  = the ground-water discharge rate (ft<sup>3</sup>/sec)

$Q_i$  = the upriver inflow (ft<sup>3</sup>/sec)

The expected dilution of ground water discharged to surface water is simply the ratio of the dilution discharge ( $Q_d$ ) to the ground-water discharge ( $Q_g$ ), or:

$$\frac{Q_d}{Q_g} = \frac{Q_o + Q_g + Q_i}{Q_g} \quad (\text{Equation 3})$$

The circulating flow of ocean water ( $Q_o$ ) is best determined by a tracer or dye study. It can also be estimated using the tidal exchange ratio (R), which is the portion of "new" water coming into the estuary on the incoming (flooding) flow. Thus, for a tidal period (T) and a tidal prism (P), the circulating flow ( $Q_o$ ) is calculated as follows:

$$Q_o = \frac{R \cdot P}{T} \quad (\text{Equation 4})$$

The tidal prism (P) can be calculated either by integration of the incoming tidal flow, or, for short estuaries such as the Rahway River, by multiplying the surface area by the tidal range. The tidal period is usually taken as 12.42 hours. The tidal exchange ratio lies between zero and one. A ratio of zero corresponds to no new water on the incoming tide, and is thus overly conservative and unrealistic for a location near a tidal entrance, such as that of the Carteret Impoundments. A ratio of one assumes that all of the incoming tidal flow is new water; this is too liberal an assumption in most settings. The tidal exchange ratio for the Rahway River is definitely greater than zero and most likely less than one.

Data from either salinity or dye tracer studies provide the best estimates for the tidal exchange ratio. For salinity data, a salt balance can be combined with Equation 4:

$$R = \frac{S_e}{S_o - S_e} \cdot \frac{Q_i T}{P} \quad (\text{Equation 5})$$

where:

$S_e$  = the average salinity leaving the estuary on the ebb flow

$S_o$  = the salinity of the "new" water entering on the flooding flow

When salinity data are available for calculating the tidal exchange ratio (R),  $Q_o$  is directly calculated as

$$Q_o = \frac{S_e}{S_o - S_e} \cdot Q_i \quad (\text{Equation 6})$$

This equation is independent of the tidal prism.

### Estimate of Dilution for Mean Theoretical Discharge to Rahway River

The mean theoretical ground-water discharge to the Rahway River is 0.01 to 0.02 cfs. The USGS measures the mean annual inflow from freshwater portions of the Rahway River as 47.9 cfs.

The cross-sectional area from the mouth of the Rahway River at the Arthur Kill to the head of the tide approximately 4.9 miles upriver has been estimated by Najaran, Thatcher and Associates (1981) for a Combined Sewer Overflow (CSO) study. These cross-sectional data have been evaluated to determine the top widths at mean water level; then the top widths were used to estimate a tidal surface area in the Rahway River of 7,200,000 ft<sup>2</sup>. The tidal prism is calculated by multiplying the surface area by the 5.0 foot mean tidal range, giving a tidal prism of 36,000,000 ft<sup>3</sup>. The actual prism will be greater, as tributary and marsh areas were not included. Review of charts and maps yields a total prism estimate of 66,700,000 ft<sup>3</sup>, which suggests that a factor of approximately two could have been applied to the estimate for the main stem of the Rahway River.

Salinity data were gathered just above the confluence of the Rahway River with the Arthur Kill on June 25 and 26, 1980.  $S_o$  is taken as 22.05 parts-per-thousand (ppt) and  $S_r$  as 20.0 ppt. During the sampling period the upstream flow ( $Q_i$ ) was 22 cfs. Substituting these values into Equation 4 gives a tidal exchange ratio of 0.67. The circulating flow of ocean water ( $Q_o$ ) calculated directly from Equation 5 is 214.6 cfs.

Dilutions for ground-water discharge were calculated for three conditions: (1) the circulating ocean flow ( $Q_o$ ) assumed equal to zero; (2)  $Q_o$  based on only a 10 percent tidal exchange ratio ( $R = 0.1$ ); and (3)  $Q_o$  is 214.6 cfs, and  $Q_i$  is 22 cfs based on the June 1980 salinity survey. These dilution estimates are as follows:

- Dilution of ground-water discharge was estimated as 2,400 to 4,800 for no tidal exchange ( $R = 0$ ) and mean annual freshwater discharge in the Rahway River of 47.9 cfs.
- Dilution of ground-water discharge was estimated as 6,400 to 12,800 for a 10 percent tidal exchange ( $R = 0.1$ ) and mean annual freshwater discharge in the Rahway River of 47.9 cfs.
- Dilution of ground-water discharge was estimated as 11,800 to 23,400 for a 67 percent tidal exchange ( $R = 0.67$ ) and upstream discharge in the Rahway River of 22 cfs, based on empirical data from the 1980 CSO study.

### 3.3.5 Comparison of Preliminary III-B GWQC to Analytical Data

Preliminary III-B GWQC for on-site ground water based on the theoretical dilution calculations are presented in Table 3-9. These concentrations were developed from the surface water criteria for protection of the SE3 Rahway River. Table 3-10 compares the maximum concentrations of contaminants of concern detected in ground-water samples to the preliminary III-B criteria for ground water. The maximum concentrations of contaminants of concern were all less than the preliminary III-B GWQC.

## **SECTION 4 - EVALUATION OF PRELIMINARY III-B CRITERIA**

### **4.1 Monitoring Program**

The primary concern at the Carteret Impoundments is potential contaminant of concern transport in ground water, and, more importantly, its possible discharge to the Rahway River. To this end, the following additional efforts were implemented to further evaluate the accuracy of hydrologic data used to develop the preliminary alternate III-B ground-water criteria:

- In-situ aquifer permeability tests (slug tests) were performed on each of the four on-site shallow and deep ground-water monitoring well clusters nearest to the Rahway River (CRT-3, CRT-4, CRT-6, and CRT-7). This was done to corroborate the M. Disko Associates [1982] hydraulic conductivity values; assess the four new monitoring wells; and obtain new hydraulic conductivity data for the deep monitoring wells.
- A long-term tidal monitoring study was implemented to monitor the effects of Rahway River tidal stages relative to shallow and deep ground water at the impoundments, as a measure of potential hydraulic connection.
- Based on the analysis of newly developed detailed geologic logs for the site, the stratigraphic relationships between ground-water units and the Rahway River were verified.

The data derived from these efforts were used to re-evaluate the Darcian approach used to calculate/estimate ground-water discharge rates to the Rahway

River under varying hydraulic gradients. Based on these re-evaluated estimates of ground-water discharge rates, the preliminary III-B GWQC were revised.

#### **4.2 Slug Tests - Procedures and Observations**

The slug tests were completed using standard testing procedures and analyses. A 5-foot-long PVC cylinder (slug) was used to simulate an instantaneous removal of ground water from the monitoring well. A Terra Systems (model Terra II) data logger and a 15-psi pressure transducer were used to digitally record both static background conditions and the hydraulic head changes resulting from the removal of the slug (rising head test). Measurements were collected in a step-wise fashion: the first 200 readings were collected at 2-second intervals; the next 200 readings were collected at 10-second intervals; and (in the event of the long duration tests) the remainder of measurements were collected at one-minute intervals. This measurement scheme allowed for an extremely detailed record of each test, while conserving data logger memory on the longer duration tests.

The digitized data were uploaded to a data file directly in the field. The data file was then imported into spreadsheet software (Quattro™ Pro for Windows, Borland™) to produce hydrographs for an initial screening of each test; to convert the hydraulic head change measurements to drawdown; and to allow the approximation of the initial drawdown (at time,  $t$ , equal to zero). These hydrographs are presented as Appendix B.

The data were then input into Aqtesolv™ Aquifer Test Design and Analysis Computer Software (Aqtesolv™) for subsequent analysis using standard type-curve matching solutions. In addition to the time/drawdown data, this analysis requires other well-specific data including the initial drawdown, the radius of the well casing, the effective radius of the well, the saturated thickness of the aquifer,

and the length of the water column in the well. These data were obtained from the respective boring/well logs. These parameters are summarized in Table 4-1.

#### **4.3 Site Hydrostratigraphy**

Prior to performing the analysis, a conceptual framework for the analysis was established. Based on a detailed comparison of the applicable boring logs, slug test hydrographs, and ground-water elevation data, the existing conceptual model for site hydrogeology (for both the unconsolidated overburden deposits and the bedrock) was slightly expanded to infer hydraulic properties. This model was partitioned into five hydrostratigraphic units:

- Fill Unit, which is divided into two sections: impoundment contents, which have been shown by Disko (1982) to exemplify very low hydraulic conductivities, so this section can therefore be classified as a confining unit; and unconsolidated debris/disturbed soils, a section which acts as an unconfined aquifer due to its stratigraphic position and coarse-grained nature. As the Fill Unit is not a factor relative to the evaluation of the slug tests, it will not be discussed further.
- Tidal Marsh Deposit, which acts as a low-yield unconfined water-bearing unit due to its stratigraphic position and fine-grained and organic-rich components
- Red (basal) clayey Sand and Gravel Unit, which acts as the primary overburden water-bearing unit due to its relatively higher porosity. This unit is confined from above by the Tidal Marsh Deposit and below by the weathered bedrock;



- Weathered Bedrock Unit which acts as a confining unit due to its fine-grained composition and semi-consolidated nature;
- Fractured Shale/Siltstone Bedrock Unit, which behaves as a confined water-bearing unit.

Ground-water movement through the overburden is controlled (in part) by each unit's primary porosity. The conceptual model recognizes that the movement of bedrock ground-water is primarily through secondary porosity features (e.g., fracture zones and faults) in the bedrock, and that flow through primary porosity features (i.e., intergranular pore spaces) is insignificant.

Under these assumptions, it is proper to analyze the slug test data from wells screened in the Tidal Marsh Deposit as representing a hydraulically unconfined unit. Although the Bouwer and Rice (1976) method can be used to simulate confined as well as unconfined aquifer systems, this method was considered appropriate for simulation of these unconfined aquifer tests. The analytical method of Cooper, Bredehoeft, and Papadopoulos is considered appropriate for the analysis of confined aquifers, and as such it initially was used to attempt to analyze slug test data from the Fractured Bedrock Unit monitoring wells (CRT-6D and CRT-7D), the Weathered Bedrock Unit wells (CRT-3D and 4-D), and the basal clayey Sand and Gravel Unit wells (CRT-6S and CRT-7S). Table 4-1 summarizes the input parameters and Aqtesolv™ results for these analyses. The Cooper, Bredehoeft, and Papadopoulos method of analysis proved unsuccessful for the two Weathered Bedrock Unit well tests, so the analysis was successfully completed using the Bouwer and Rice procedures. The data plots for these tests are included with this report as Figures I through P (Appendix C). A detailed review of each aquifer test follows:

- The **CRT-3S** test results depict the time-verses-drawdown response of a very low permeability formation. The initial drawdown in the well, caused by the removal of the PVC slug, was 2.23 feet, as is proper for a slug of the size used for the test. By the end of the test (110 minutes), the total hydraulic recovery was only 0.6 foot, 0.3 foot of which occurred in the first 15 seconds and is probably attributable to well casing and sand-pack effects. The section of data from 15 seconds to the end of the test was used for the Aqtesolv™ analysis. The drillers' log for CRT-3S indicates the well was screened from 15 to 25 feet BGS, in a "black organic sand" unit. Based on field observations and cross-correlation of this unit's surface and base elevation to more recent (and significantly more detailed) boring logs (CRT-6D through CRT-8D, [BBL RAP 1994]), the unit referenced is a dark grey clay and peat-rich Tidal Marsh Deposit. A strong correlation exists between these slug test results and the anticipated response for a well screened in such a deposit.
- The **CRT-3D** test results depict the time-verses-drawdown response of either a very low permeability formation or extremely poor well construction conditions (i.e., no connection with the hydraulic system in which the well is set). The initial drawdown in the well, caused by the removal of the PVC slug, was 1.91 feet. By the end of the test (110 minutes), the total hydraulic recovery was less than 0.09 foot. Under the assumption that the well is not totally isolated from the formation, all of the data were used for the Aqtesolv™ analysis. The driller's log for CRT-3D indicates the well was screened from 48 to 58 feet BGS, in a "grey siltstone" unit. However, neither the presence of water-bearing bedrock fracture zones or other source of ground water

are noted on the logs. Based on field observations and cross-correlation of this unit's surface and base elevation to more recent and more detailed boring logs (CRT-6D through CRT-8D, [BBL RAP 1994]), the well was probably screened in the upper weathered zone of bedrock, which is considered to be a confining unit. A strong correlation exists between these slug test results and the anticipated response for a well screened in such a unit.

In confirmation of this assumption, the slug test data were analyzed by both the Bouwer and Rice method and the Cooper, Bredehoeft, and Papadopoulos method. Even after applying an unrealistically large variation in potential unit storage, the Cooper, Bredehoeft, and Papadopoulos method could not reasonably approximate a type curve match to the data. Conversely, the Bouwer and Rice method showed a relatively good match to the data, and the results from using this method are provided herein.

- The **CRT-4S** test response is also typical of a very low permeability formation. The data depict rapid sandpack drainage (prior to 20 seconds from the start of the test) and a section of apparently good data which is representative of the formation (from 20 seconds to 7 minutes). This latter section was used for the Aqtesolv™ analysis by the method of Bouwer and Rice. As at CRT-3S, this well appears to be screened in the Tidal Marsh Deposit. A strong correlation exists between these slug test results and the anticipated response for a well screened in such a unit.

- The **CRT-4D** test results also depict data typical of a very low permeability formation. The initial drawdown in the well, caused by the removal of the PVC slug, was 1.90 feet. By the end of the test (275 minutes), the total hydraulic recovery was less than 0.6 foot. All of the data were used for the Aqtesolv™ analysis. Comparable to CRT-3D, the driller's log for CRT-4D indicates the well was screened from 32 to 42 feet BGS, in a "siltstone" unit. As above, field observations and cross-correlation of this unit's surface and base elevation to more recent (and significantly more detailed) boring logs (CRT-6D through CRT-8D, [BBL RAP 1994]) suggest the well is screened in the upper weathered zone of bedrock, which is considered a confining unit. A strong correlation exists between these slug test results and the anticipated response for a well screened in such a unit.

As in the case of CRT-3D, the slug test data were analyzed by both the Bouwer and Rice method (unconfined or confined conditions) and the Cooper, Bredehoeft, and Papadopoulos method (confined conditions). Even after applying an unrealistically large variation in potential unit storage, the Cooper, Bredehoeft, and Papadopoulos method could not reasonably approximate a type curve match to the data. Conversely, the Bouwer and Rice method showed a relatively good match to the data, therefore, the results from using this method are provided herein.

- The **CRT-6S** test results depict smooth, apparently good formation data from the start of the test to 4.5 minutes, and apparent noise from 4.5 minutes to the end of the test. The former section was used for analysis by the method of Cooper, Bredehoeft, and Papadopoulos. This well is screened in the basal clayey Sand and Gravel Unit. A strong

correlation exists between these slug test results and the anticipated response for a well screened in such a unit.

- The **CRT-6D** test results depict data which are typical of a very low storage/relatively high permeability unit, which is characteristic of a bedrock fracture system. The initial drawdown in the well, caused by the removal of the PVC slug, was 1.85 feet. By the effective end of the test (12 minutes), the total hydraulic recovery was 1.83 feet. After 12 minutes, it was apparent that tidal effects from the nearby Rahway River were affecting the data, and therefore only the earlier data were used for analysis, by the Cooper, Bredehoeft, and Papadopoulos. Although boring logs indicate that water in this well primarily originates from three small (<0.5 ft.) fractures at 55, 60, and 62 feet BGS, the test was analyzed assuming the source of the water was the entire screened interval (10 feet). Well construction details precluded the isolation of individual fracture sets. In the context of this analysis, this does not present a problem. Minor deviations from this type-curve exist prior to one minute from the start of the test, most likely resulting from well construction (i.e., sandpack effects in the bedrock borehole).
- The **CRT-7S** slug test results, exhibit significant curve distortion, most likely as a result of tidal effects. The initial drawdown in the well, caused by the removal of the PVC slug, was 1.85 feet. By the effective end of the test (80 minutes, when tidal effects reversed recovery conditions), the total hydraulic recovery was 1.50 feet. The analysis of the test was completed by the method of Cooper, Bredehoeft, and Papadopoulos. The data presented represent the best

statistical type-curve match to the data. This well is screened in the basal clayey Sand and Gravel Unit. A correlation exists between these slug test results and the anticipated response for a well screened in such a unit.

- The **CRT-7D** test results depict data which are typical of a very low storage/ relatively high permeability unit, which is characteristic of a bedrock fracture system. The initial drawdown in the well, caused by the removal of the PVC slug, was 2.10 feet. By the end of the test (3 minutes), the recovery was complete. All of the data were used for the Aqtesolv™ analysis. Although boring logs indicate that water in this well primarily originates from two small (<0.5 ft.) fractures at 39 and 59 feet BGS, the test was analyzed assuming the source of the water was the entire screened interval (25 feet). Minor deviations from the type-curve exist prior to one minute from the start of the test, most likely resulting from well construction (i.e., sandpack effects in the bedrock borehole). The analysis of the test was completed by the method of Cooper, Bredehoeft, and Papadopoulos.

Based on these curve matches, the average horizontal hydraulic conductivities of the hydrostratigraphic units are:

- Tidal Marsh Deposit -  $2.2\text{E-}5$  ft/min ( $1.1\text{E-}5$  cm/sec);
- Red (basal) clayey Sand and Gravel Unit -  $9.7\text{E-}4$  ft/min ( $4.91\text{E-}4$  cm/sec);
- Weathered Bedrock Unit -  $3.9\text{E-}6$  ft/min ( $2.0\text{E-}6$  cm/sec); and
- Fractured Shale/Siltstone Bedrock Unit -  $3.6\text{E-}3$  ft/min ( $1.8\text{E-}3$  cm/sec).

#### **4.4 Tidal Monitoring Study**

This study included: the establishment of river gauges in the Rahway River; the collection of detailed ground-water and surface water level data over a 140-hour (10-tidal cycle) period; the compilation/reduction of these data to the form of ground-water and surface water elevation hydrographs; the calculation of mean ground-water and surface water elevations over the monitoring period; and the construction of shallow and deep ground-water equipotential maps.

##### **4.4.1 Installation of River Gauges**

The purpose of a river gauge is to monitor river elevation and, hence, tidal fluctuation in the main channel of the river. At high tide, the river fills its banks and is approximately 200 feet across. At low tide, flow is diminished to strictly the main channel, which is roughly 50 feet across. As a result, at low tide an expansive (non-transversable) mud flat fringes the impoundments. As access to the main river channel near the Carteret Impoundments was extremely limited at low tide, two river gauges were set in the Rahway River. The primary river gauge was set approximately 4,000 feet downstream of the impoundments (at the Cytex Warners Plant), on the northern bank of the main channel. This gauge consisted of both a stilling well (to allow use of a pressure transducer) and a commercially purchased river staff gauge, which was calibrated with 100th of a foot intervals. This was done to allow calibration of the pressure transducer system from the shore. A secondary river gauge (stilling well only) was set approximately 110 feet west of ground-water monitoring wells CRT-4S and CRT-4D. Due to the access limitations described above, the secondary river gauge could only monitor high tides and not the entire tidal cycle. Data from the secondary river gauge was used to confirm correlation of data (particularly tidal phase) between the primary gauge and the on-site data.

#### 4.4.2 Detailed Ground-Water and Surface Water Level Data Collection

Pressure transducer/data logger systems were installed in the four monitoring well clusters located closest to the river (CRT-3, CRT-4, CRT-6, and CRT-7) and at both river gauges. These systems were used to collect synoptic ground-water and surface water level data from each of the ground-water and surface water monitoring points at 15-minute intervals for 140 hours. The data loggers recorded 10 complete tidal cycles. The data were recorded as feet of head above the pressure transducer.

Two rounds of ground-water and river-level measurements were collected using a calibrated, electronic water-level probe. One round was collected at the start of the tidal monitoring program, and the other at the end. These measurements were made: to calculate shallow and deep ground-water elevations; to establish the elevation of the Rahway River at the impoundments; to insure accurate calibration of the pressure transducer systems; and to confirm the accuracy of the pressure transducer system at the end of the tidal monitoring study.

Data from the data logger/pressure transducer systems were electronically uploaded and stored as an ASCII format data file.

#### 4.4.3 Data Reduction, Hydrographs, and Mapping

The hydraulic head data collected by the tidal monitoring program were evaluated using a computerized spreadsheet (Quattro Pro for Windows) for subsequent conversion to elevation (Mean Sea Level [MSL]), plotting, and averaging. Figures 4-1 through 4-4 present the compilation/reduction of these data as ground-water and surface water elevation hydrographs. Each figure presents the details of the study on a well cluster basis and includes: shallow well data; bedrock well data; data from the Rahway River at the primary river gauge (at the Warners Plant [RR@WP]); and data from the Rahway River at the secondary river gauge (at the Carteret



Impoundments [RR@CI]) The mean ground-water/surface water elevation at each point was calculated by averaging, using the Rahway River peak tidal cycles as reference. The data used for the average were collected from the peak low tide on 12/23 (am) through the peak high tide on 12/28 (pm). These data are included on the Tidal Effect Monitoring Hydrographs.

- Review of the Tidal Effect Monitoring Hydrograph for the CRT-3 cluster (Figure 4-1) indicates minimal evidence of tidal effects in either well. Correlating these data to the slug test results supports the theory that these wells are screened (inappropriately) in the Tidal Marsh Deposit (CRT-3S) and the Weathered Bedrock Unit (CRT-3D). These data also support the conceptual model which suggests that the Tidal Marsh Deposit (CRT-3S) and the Weathered Bedrock Unit (CRT-3D) hydraulically behave as confining units.

Ground-water/surface water elevation data indicate that the mean Weathered Bedrock Unit ground-water elevation is significantly higher than that of the Tidal Marsh Deposit and the Rahway River at the site, indicating an upward potential hydraulic gradient. This scenario represents a potential for ground water from both units to discharge to the river.

- Review of the Tidal Effect Monitoring Hydrograph for the CRT-4 cluster (Figure 4-2) indicates minimal evidence of tidal effects in the shallow well, supporting the theory that this well is screened in the Tidal Marsh Deposit (CRT-4S) and the conceptual model

which suggests that the Tidal Marsh Deposit hydraulically behaves as confining unit. The response of CRT-4D to tidal fluctuations is anomalous, but believed to be related to the well's construction. While peak tidal responses in this well lag only slightly behind tidal fluctuation in the river, the magnitude of the fluctuations are approximately double the effects seen in other bedrock wells. As this well cluster is closest to the main channel of the river, it is believed that the observed effects are related to pressure gradients caused by the river stage. Given the hydraulic conductivity observed at this well, it is highly unlikely that these fluctuations are related to actual mass transfer of ground water to surface water.

Ground-water/surface water elevation data indicate that the mean Weathered Bedrock Unit ground-water elevation is higher than that of the Rahway River at the Carteret Impoundments, but lower than that of the Tidal Marsh Deposit. This indicates that hydraulic gradients from both the Weathered Bedrock Unit and the Tidal Marsh Deposit favor discharge to the river.

- Review of the Tidal Effect Monitoring Hydrograph for the CRT-6 cluster (Figure 4-3) indicates strong evidence of tidal effects in both the basal clayey Sand and Gravel Unit and the Fractured Shale/Siltstone Bedrock Unit, supporting the conceptual model which suggests that these are primary ground-water transmitting units. Peak tidal responses in both wells lag only slightly behind tidal fluctuation in the river. The magnitude of the tidal effect fluctuations is approximately equal in both wells.

The ground-water/surface water elevation data indicate that the mean Fractured Shale/Siltstone Bedrock Unit ground-water elevation is higher than that of the Rahway River at the Warners Plant and the basal clayey Sand and Gravel Unit. This indicates that hydraulic gradients from both the bedrock and the overburden unit favor discharge to the River.

- Review of the Tidal Effect Monitoring Hydrograph for the CRT-7 cluster (Figure 4-4) likewise indicates strong evidence of tidal effects in both the basal clayey Sand and Gravel Unit and the Fractured Shale/Siltstone Bedrock Unit, supporting the conceptual model which suggests that these are primary ground-water transmitting units. Peak tidal responses in both wells lag only slightly behind tidal fluctuation in the river. The magnitude of the tidal effect fluctuations is approximately equal in both wells.

Ground-water/surface water elevation data indicate that the mean Fractured Shale/Siltstone Bedrock Unit ground-water elevation is higher than that of the Rahway River at the Warners Plant and the basal clayey Sand and Gravel Unit. This indicates that hydraulic gradients from both the bedrock and the overburden unit favor discharge to the river.

The mean elevation data were subsequently used to construct shallow and deep equipotential maps by plotting the mean ground-water elevation data using the Geosoft Mapping and Processing System (Geosoft™). The mean ground-water elevation data are plotted on Figures 4-5 and 4-6. Since these figures represent mean elevation data developed from "suspect" monitoring wells (CRT

3 and 4) screened in both the Tidal Marsh Deposit and Weathered Bedrock Unit, the data points have not been contoured.

#### **4.5 Analysis of Tidal Effects on Ground-Water Flow**

The ground-water flow patterns inferred by the mean ground-water elevation maps for the CRT-3, CRT-4, CRT-6, and CRT-7 well clusters show patterns which are similar for both bedrock and overburden units. Ground water in both units appears to flow from the southwest toward the northeast and then radially to the river. However, it must be noted that the four wells shown in each of these two figures are not all screened in comparable hydrostratigraphic units.

The well clusters studied support a mean upward hydraulic gradient and potential for mean discharge to the Rahway River. With the exception of CRT-4, all of the clusters studied also indicate an upward hydraulic gradient from bedrock to the overburden. Based on the findings of these supplemental activities, the anomalous data observed at CRT-4 are currently believed to be the result of poor well construction.

#### **4.6 Revised Flow Calculations**

Based on the additional hydraulic data developed relative to multiple permeability zones in the overburden and under the presumption that the earlier data quality does not support the level of detail presented in the previous discharge calculations, new ground-water discharge calculations were developed using mean (averaged) data. This allowed compensation for small scale irregularities in the database. As true bedrock ground-water quality has been shown to be unaffected and, in fact, an upward hydraulic gradient is apparent relative to affected zones, it will not be included as a factor in these discharge calculations.

To calculate the ground-water discharge using Darcy's Law, the following four parameters must be known about each unit: the hydraulic gradient (i); the hydraulic conductivity (K); the effective porosity ( $\eta$ ); and the cross-sectional area (A). These parameters are related such that:

$$\text{Seepage velocity (v)} = K (i) / \eta$$

and:

$$\text{Ground-water discharge} = vA$$

Table 4-2 summarizes and applies these parameters for each of the units.

- The hydraulic gradient is equal to the change in hydraulic head (dh) divided by the distance (dL - measured perpendicular to flow) between the monitoring points (the perimeter monitoring wells) and the main Rahway River channel. The mean hydraulic gradient is 0.0063 (dimensionless).
- The mean hydraulic conductivity of the Tidal Marsh Deposit is 3.14 e-2 ft/day. The mean hydraulic conductivity of the Sand and Gravel Unit is 1.39E0 ft/day.
- The effective porosity of the Tidal Marsh Deposit is approximately 50%, and that of the Sand and Gravel Unit is approximately 25% (Freeze and Cherry, pg. 37).

Substituting the above parameters into the equation yields a seepage velocity equal to 3.9E-4 ft/day in the Tidal Marsh Deposit, and 3.5E-2 ft/day in the Sand and Gravel Unit.

The area of the discharge zone is equal to the length of the discharge boundary multiplied by the mean saturated thickness of each unit.

- Based on ground-water elevation data, the largest theoretical discharge boundary starts at the property corner located west of CRT-7 and extends (paralleling the shore line) around the peninsula to the mouth of Deep Creek. This distance is equal to approximately 3,370 feet.
- From detailed boring log data, extrapolation, and ground-water elevation data, the mean saturated thickness of the Tidal Marsh Deposit is 20.17 feet and the mean saturated thickness of the Sand and Gravel Unit is 5.76 feet.
- Multiplying these thicknesses by the discharge boundary length results in discharge areas equal to approximately 68,000 ft<sup>2</sup> and 19,410 ft<sup>2</sup> for the Tidal Marsh Deposit and the Sand and Gravel Unit, respectively.

Substituting the above parameters into the equation yields individual ground-water discharge rates of 27 ft<sup>3</sup>/day (200 gpd) and 679 ft<sup>3</sup>/day (5075 gpd) for the Tidal Marsh Deposit and the Sand and Gravel Unit, respectively. The site-specific combined overburden discharge to the Rahway River can be estimated at 5,275 gpd.

#### 4.7 Development of III-B GWQC and Comparison to Analytical Data

The site-specific combined overburden discharge to the Rahway River is 5,275 gpd or 0.00816 cfs. Dilutions for ground-water discharge were calculated for three conditions: (1) the circulating ocean flow ( $Q_o$ ) assumed to be equal to

zero; (2)  $Q_0$  based on only a 10 percent tidal exchange ratio ( $R=0.1$ ); and (3)  $Q_0$  is 214.6 cfs, and  $Q_1$  is 22 cfs based on the June 1980 salinity survey. These dilution estimates are as follows:

- Dilution of ground-water discharge was estimated as 6,000 for no tidal exchange ( $R = 0$ ) and mean annual freshwater discharge in the Rahway River of 47.9 cfs;
- Dilution of ground-water discharge was estimated as 16,000 for a 10 percent tidal exchange ( $R=0.1$ ) and mean annual freshwater discharge in the Rahway River of 47.9 cfs; and
- Dilution of ground-water discharge was estimated as 29,500 for a 67 percent tidal exchange ( $R=0.67$ ) and upstream discharge in the Rahway River of 22 cfs, based on empirical data from the 1980 CSO study.

Table 4-3 provides a summary of III-B GWQC which were calculated using the site-specific overburden discharge rates. The results do not vary significantly from the preliminary III-B GWQC. Table 4-4 compares the maximum concentrations of contaminants of concern detected in ground-water samples to the III-B GWQC. Maximum concentrations of contaminants of concern occur at concentrations less than the III-B GWQC.

## SECTION 5 - MONITORING PROGRAM

### 5.1 Semi-Annual Ground-Water and Surface Water Quality Monitoring

To evaluate compliance with the alternate III-B ground-water quality standards, a five-year Monitoring Plan is proposed. This monitoring program includes both ground-water and surface water monitoring. Table 5-1 provides a summary of the implementation schedule for the five-year semi-annual ground-water and surface water monitoring program. Both monitoring programs would consist of semi-annual monitoring for free and total cyanide and annual monitoring for trace metals. Samples would be collected from all on-site monitoring wells and at the three designated surface water locations in Deep Creek for a period of five years. Tables 5-2 and 5-3 provide respective examples of the surface water and ground-water summary tables that would be submitted as part of the monitoring program.

At the end of five-year period, the data would be analyzed to identify trends and determine the requirements for additional monitoring, if any. Thus, future ground-water and surface water conditions will be monitored to determine if they have improved or if there is a need to re-evaluate the appropriateness of the alternate III-B ground-water quality criteria.

### 5.2 Restricted Uses at the Site

The NJDEP "Declaration of Environmental Restrictions" (DER), dated August 13, 1993, was reviewed to identify use restrictions compatible with the site conditions. Based on the general restrictions outlined in the DER, the following current and future restricted uses were identified for the site:

#### current use restrictions

- continued management of the residues already impounded; and



- continued maintenance and monitoring activities as outlined in the RAP (BBL 1994) by designated personnel.

#### future use restrictions

- control access by posting additional signs along the frontage of the Rahway River and the Arthur Kill to deter trespassing, as outlined in the RAP (BBL 1994). Overland access to the impoundments is not considered a potential problem because the two access points are currently controlled with locked gates; and
- no alteration, improvement, or disturbance in, to, or about the impoundments and any affected areas which create an unacceptable risk to humans or other receptors from exposure to impounded residue, or results in a disturbance of any engineering control designed to contain or reduce exposure to the residue, without prior written consent of the NJDEP.

Consent of the NJDEP will not be required for alteration, improvement, maintenance, monitoring, or other disturbance that meets the following criteria:

- provides for restoration of any disturbance of an engineering control to pre-disturbance conditions in a timely manner;
- does not allow exposure level above those noted under Restricted Uses, provided that all applicable worker health and safety laws and regulations are followed during the activity.

The restricted uses shall be reviewed at the end of the proposed five-year monitoring program to reevaluate their applicability to existing site

conditions. If necessary, modifications to the identified restricted uses shall be made at that time.

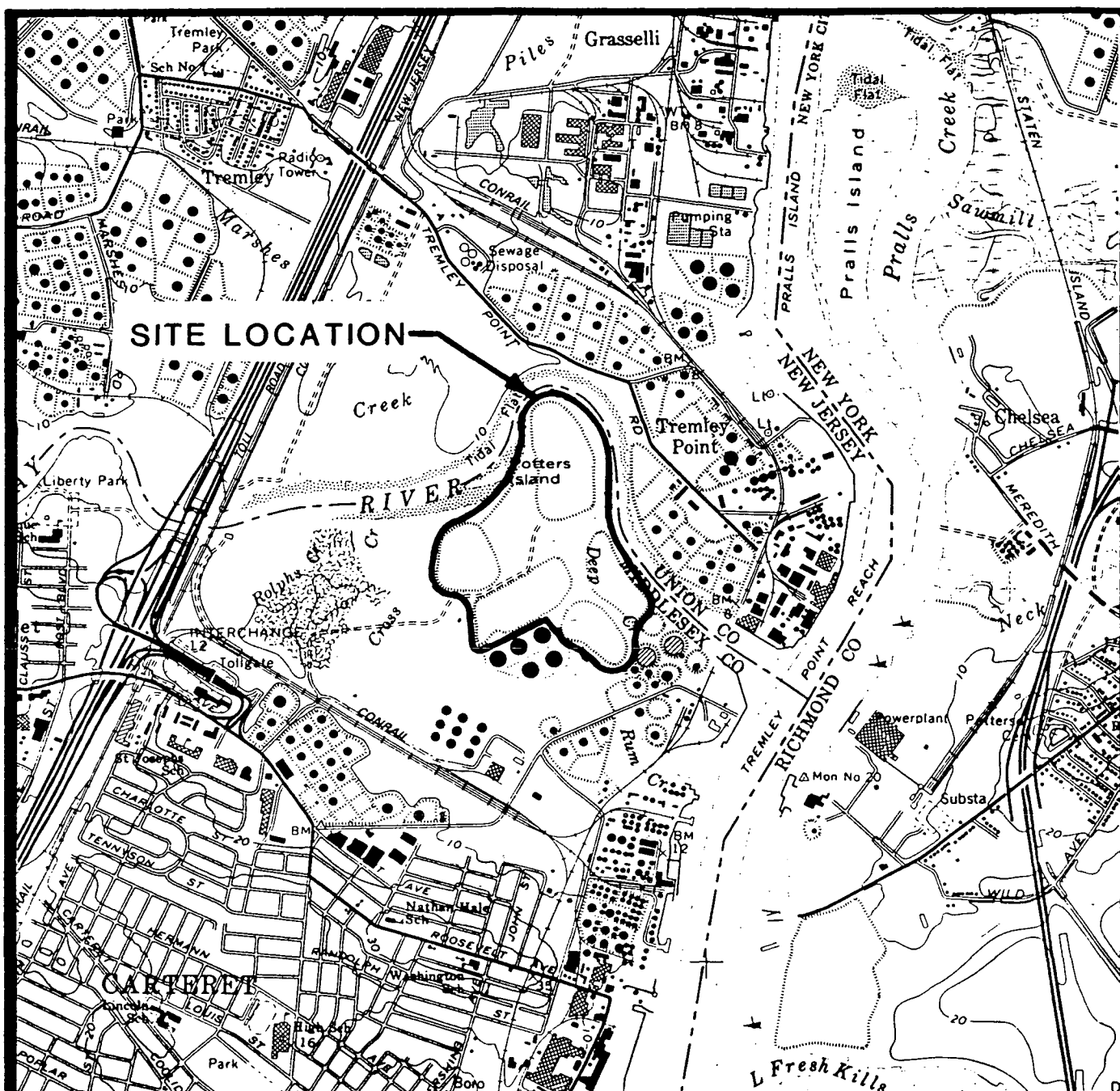
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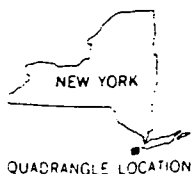


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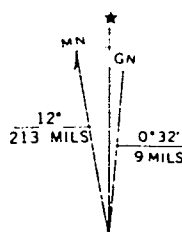
— ARTHUR KILL, N.Y.,N.J.  
7.5 MINUTE QUADRANGLE  
CONTOUR INTERVAL 10 FEET

2000' 0 2000'

APPROX. SCALE: 1" = 2,000'



QUADRANGLE LOCATION



UTM GRID AND 1981 MAGNETIC NORTH  
DECLINATION AT CENTER OF SHEET



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REMEDIAL ACTION PLAN ADDENDUM

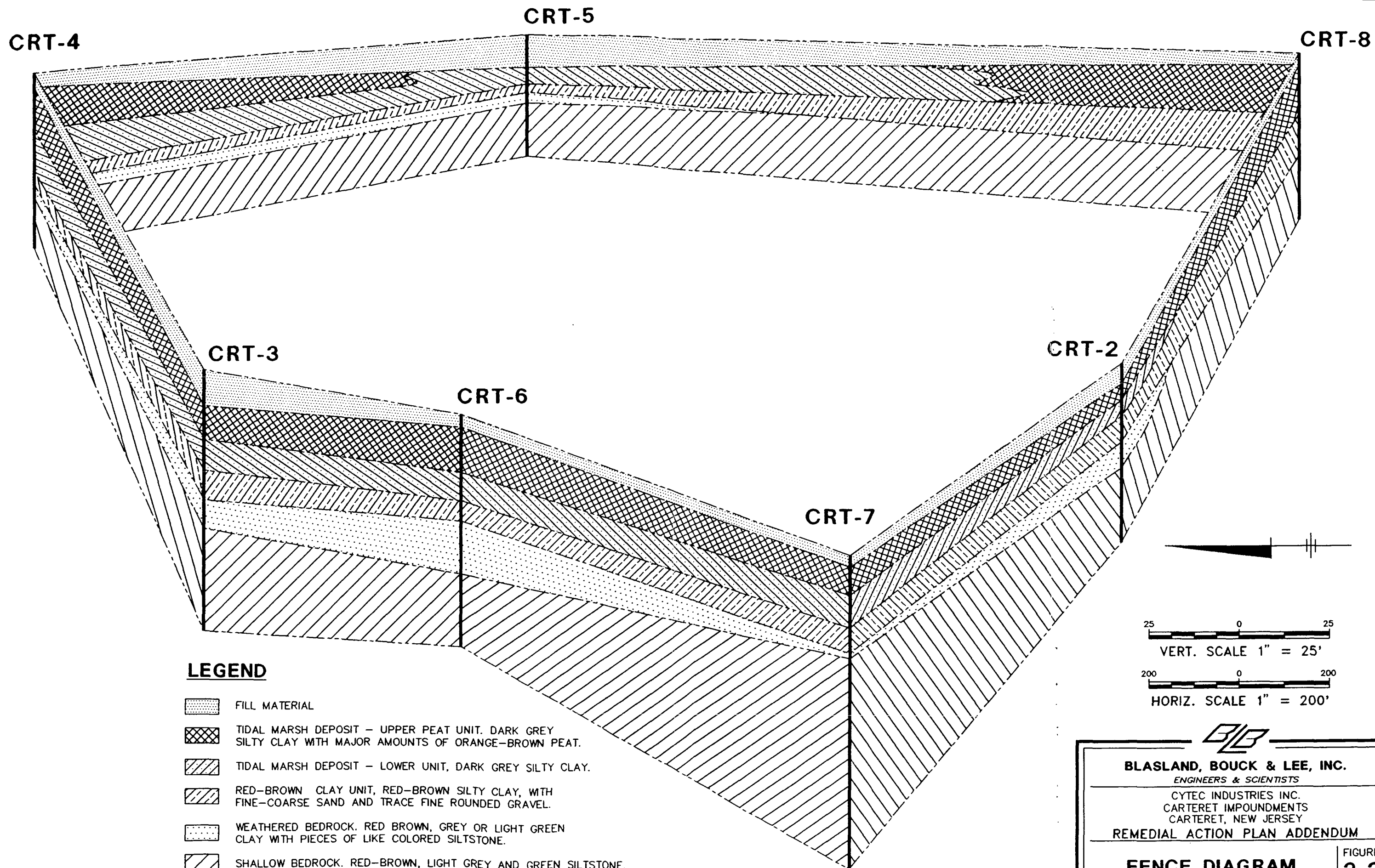
**SITE LOCATION  
MAP**

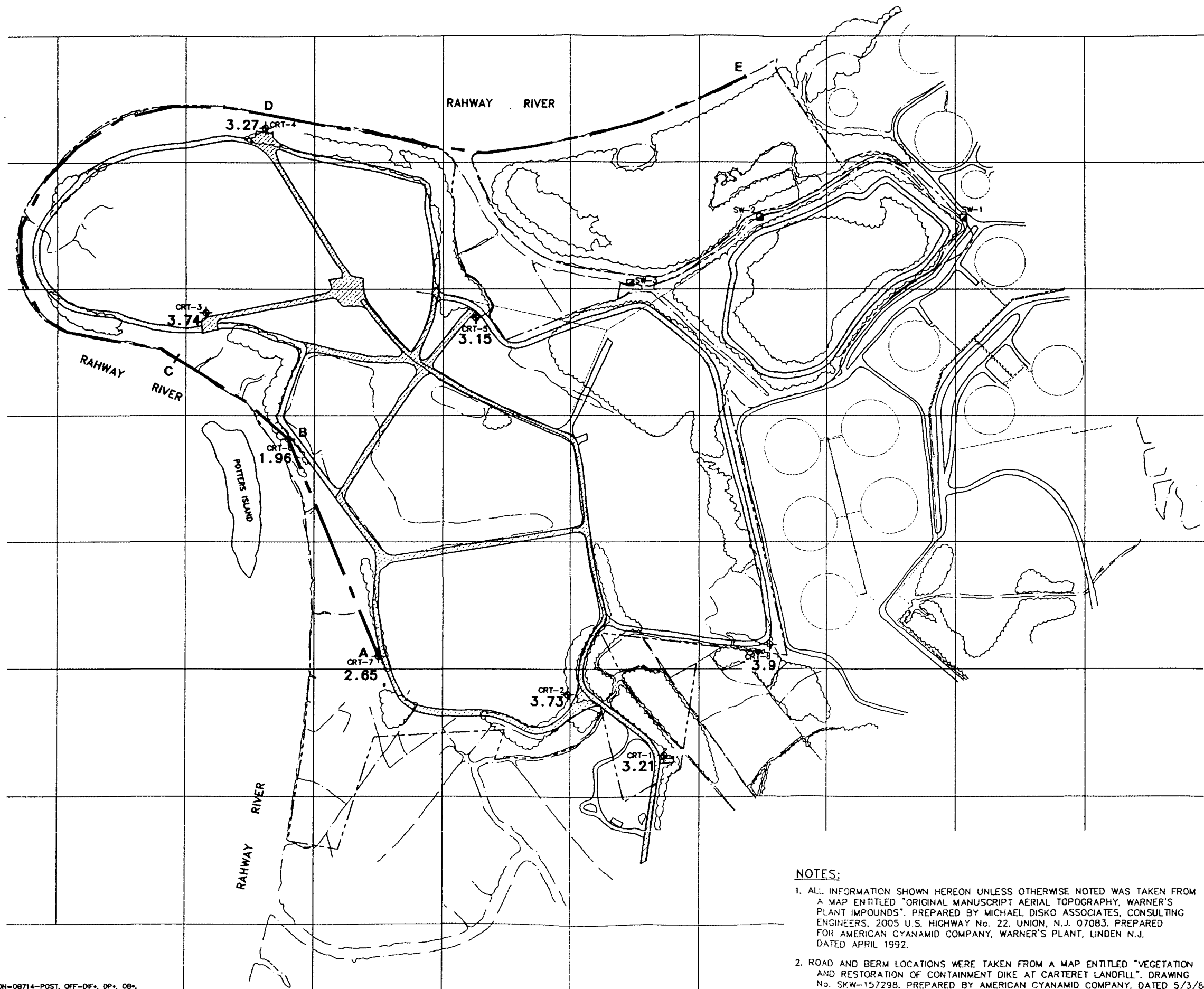
FIGURE

**1-1**

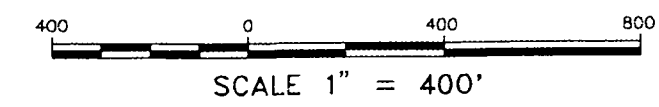


## FIGURES






- LEGEND**
- CRT-8 EXISTING WELL CLUSTER LOCATION (APPROXIMATE)
  - SW-1 SURFACE-WATER SAMPLING LOCATIONS (APPROXIMATE)
  - ROAD
  - BERM
  - PROPERTY LINE LOCATION (APPROXIMATE)
  - GROUND-WATER DISCHARGE LINE



**NOTES:**

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2. ROAD AND BERM LOCATIONS WERE TAKEN FROM A MAP ENTITLED "VEGETATION AND RESTORATION OF CONTAINMENT DIKE AT CARTERET LANDFILL". DRAWING No. SKW-157298. PREPARED BY AMERICAN CYANAMID COMPANY. DATED 5/3/88 AND REVISED 1/9/89.



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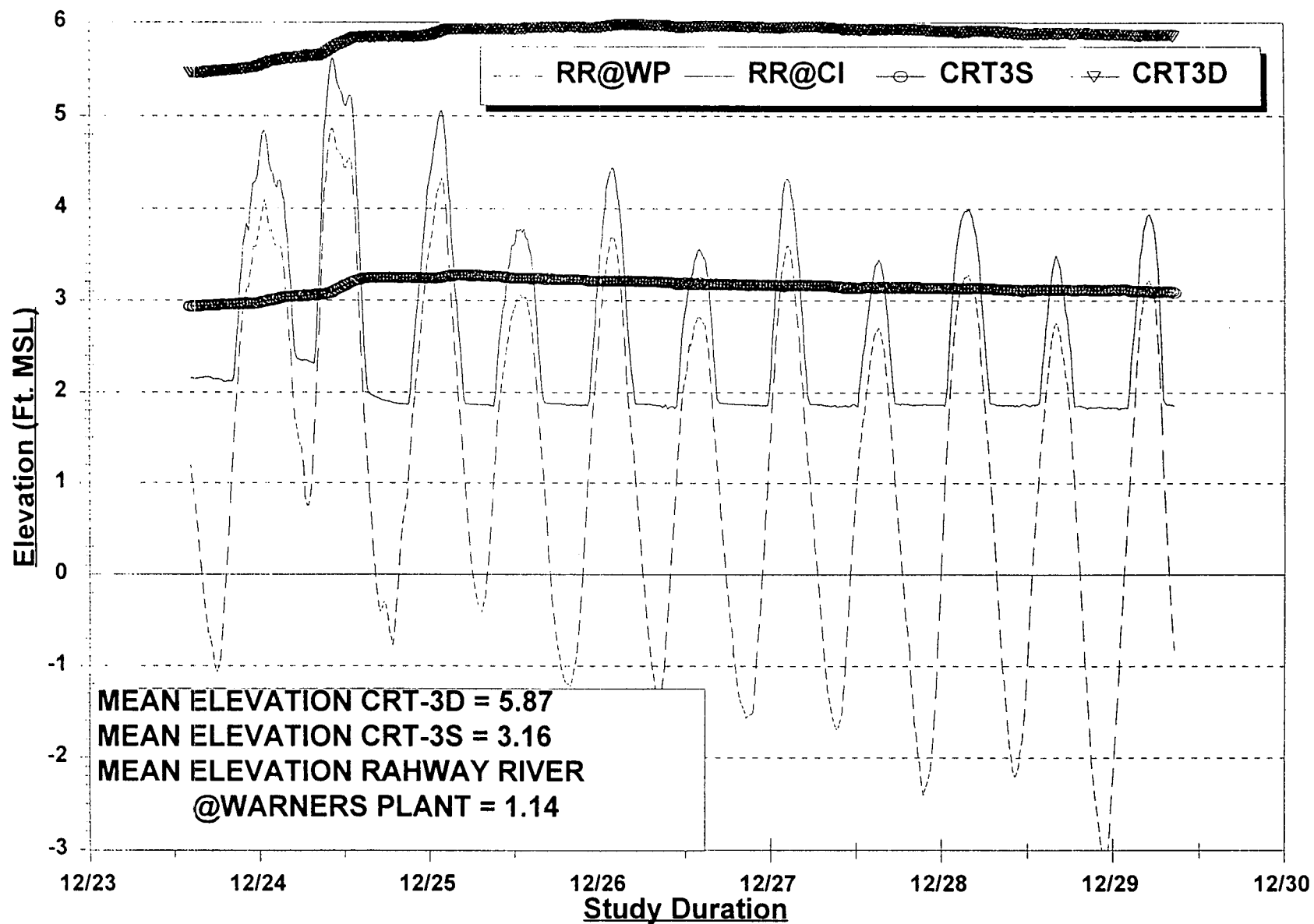
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CARTERET, NEW JERSEY

**REMEDIAL ACTION PLAN ADDENDUM**  
**OVERBURDEN GROUND-WATER ELEVATIONS**  
**7/14/94 (HIGH TIDE)**

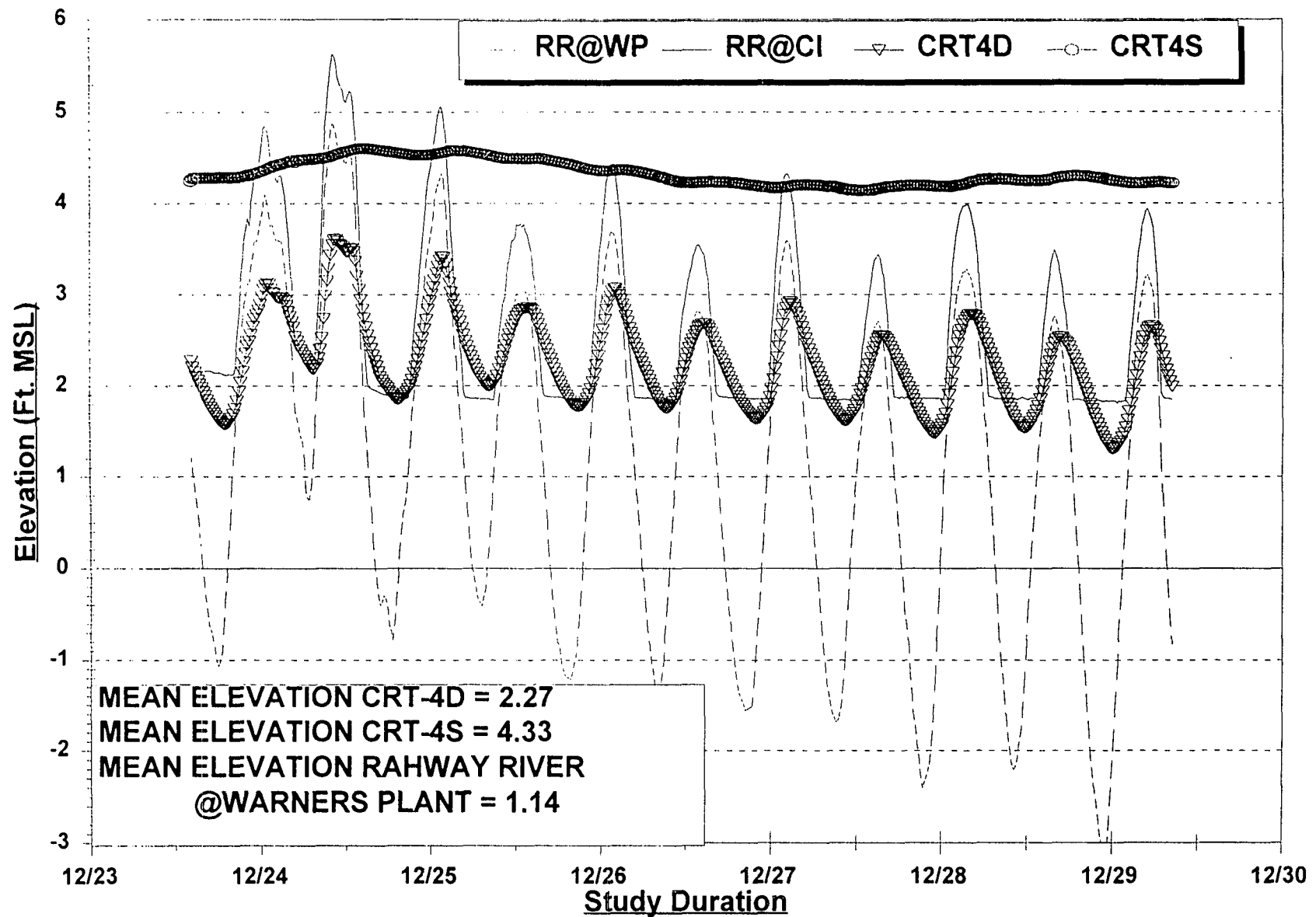
FIGURE  
**2-3**



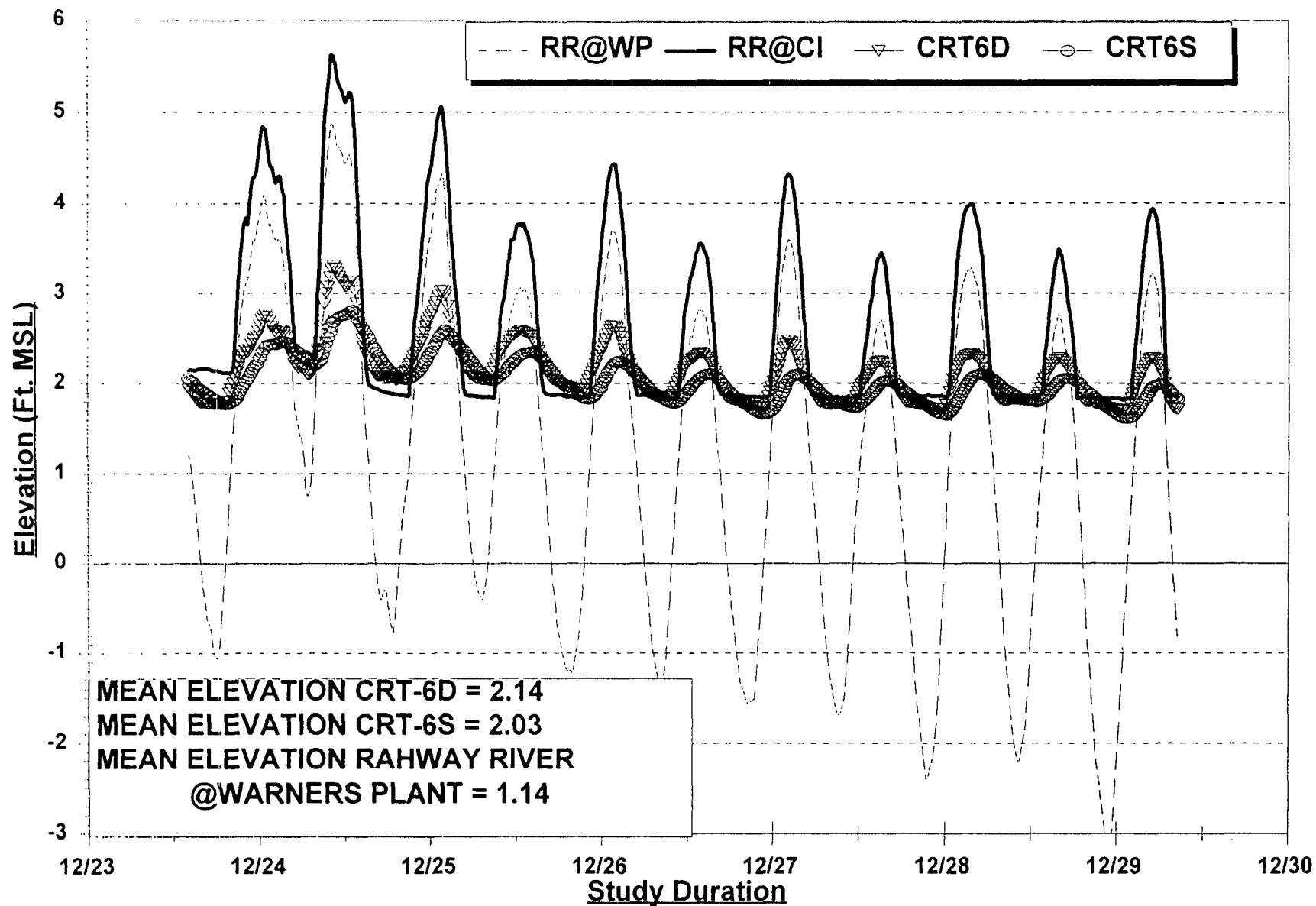
**FIGURE 4-1**  
**TIDAL EFFECT MONITORING HYDROGRAPH CRT-3**



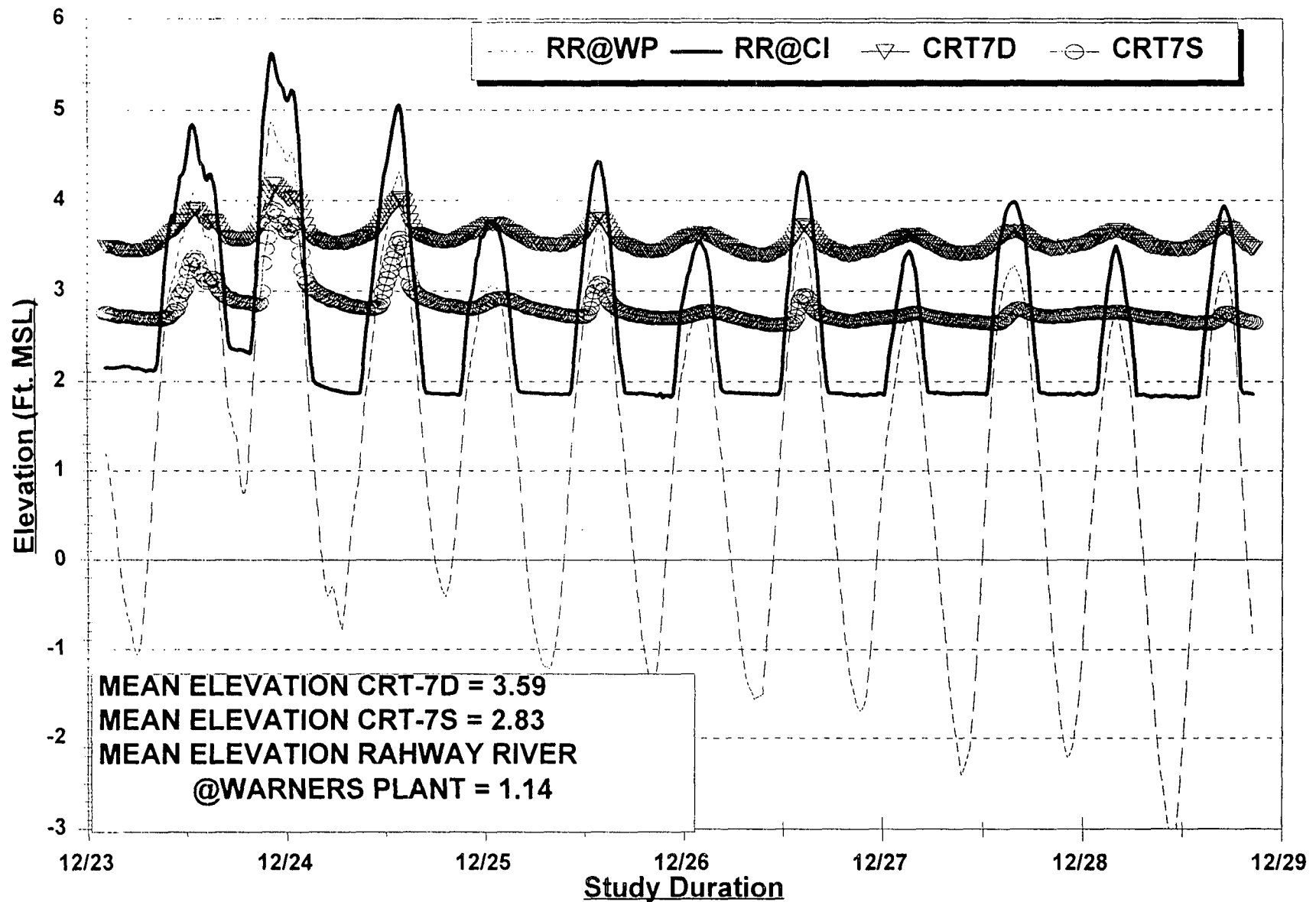
**FIGURE 4-2**  
**TIDAL EFFECT MONITORING HYDROGRAPH CRT-4**

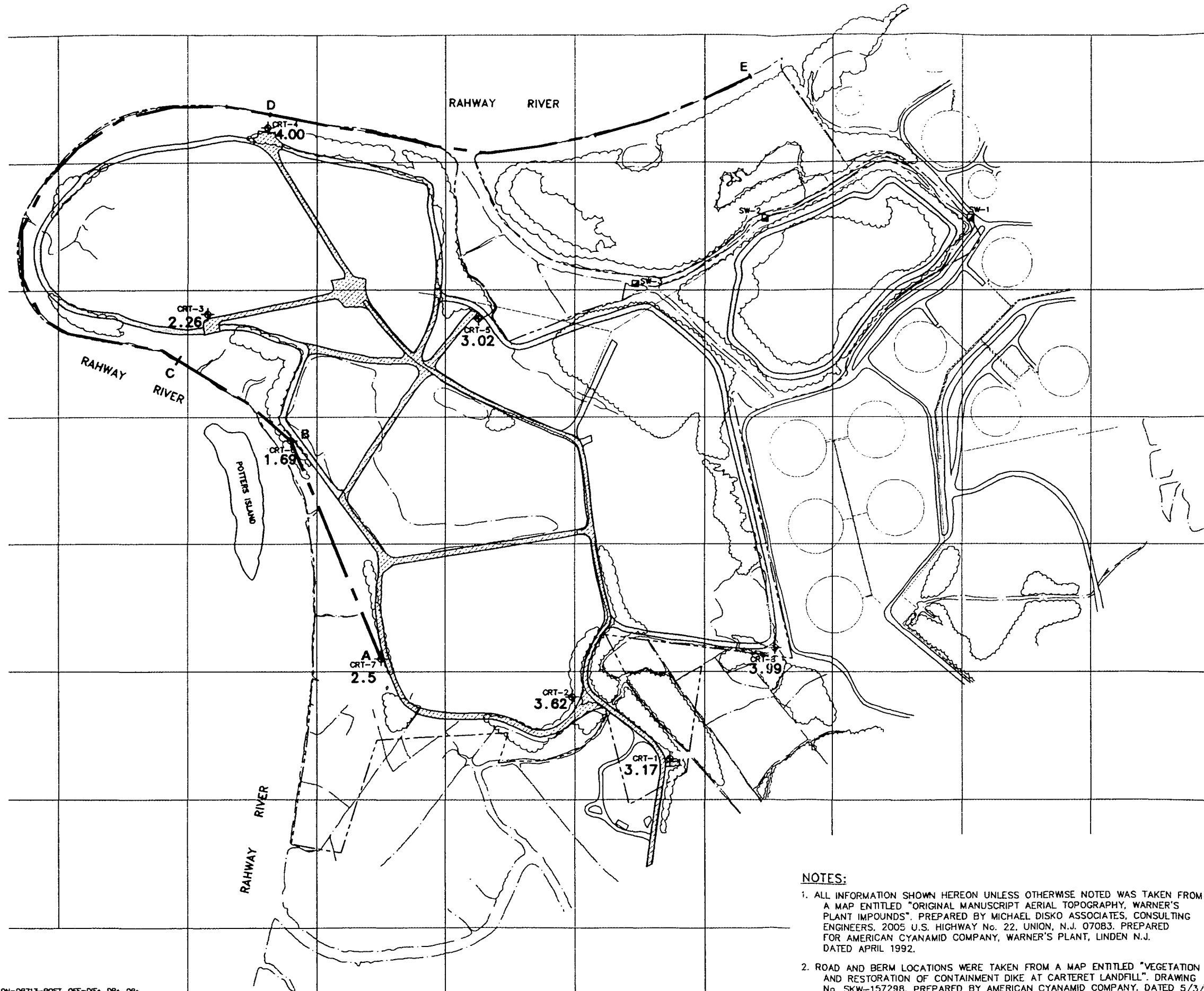


**FIGURE 4-3**  
**TIDAL EFFECT MONITORING HYDROGRAPH CRT-6**



**FIGURE 4-4**  
**TIDAL EFFECT MONITORING HYDROGRAPH CRT-7**





- LEGEND**
- CRT-8 EXISTING WELL CLUSTER LOCATION (APPROXIMATE)
  - SW-1 SURFACE-WATER SAMPLING LOCATIONS (APPROXIMATE)
  - ROAD
  - BERM
  - PROPERTY LINE LOCATION (APPROXIMATE)
  - GROUND-WATER DISCHARGE LINE

400 0 400 800  
SCALE 1" = 400'

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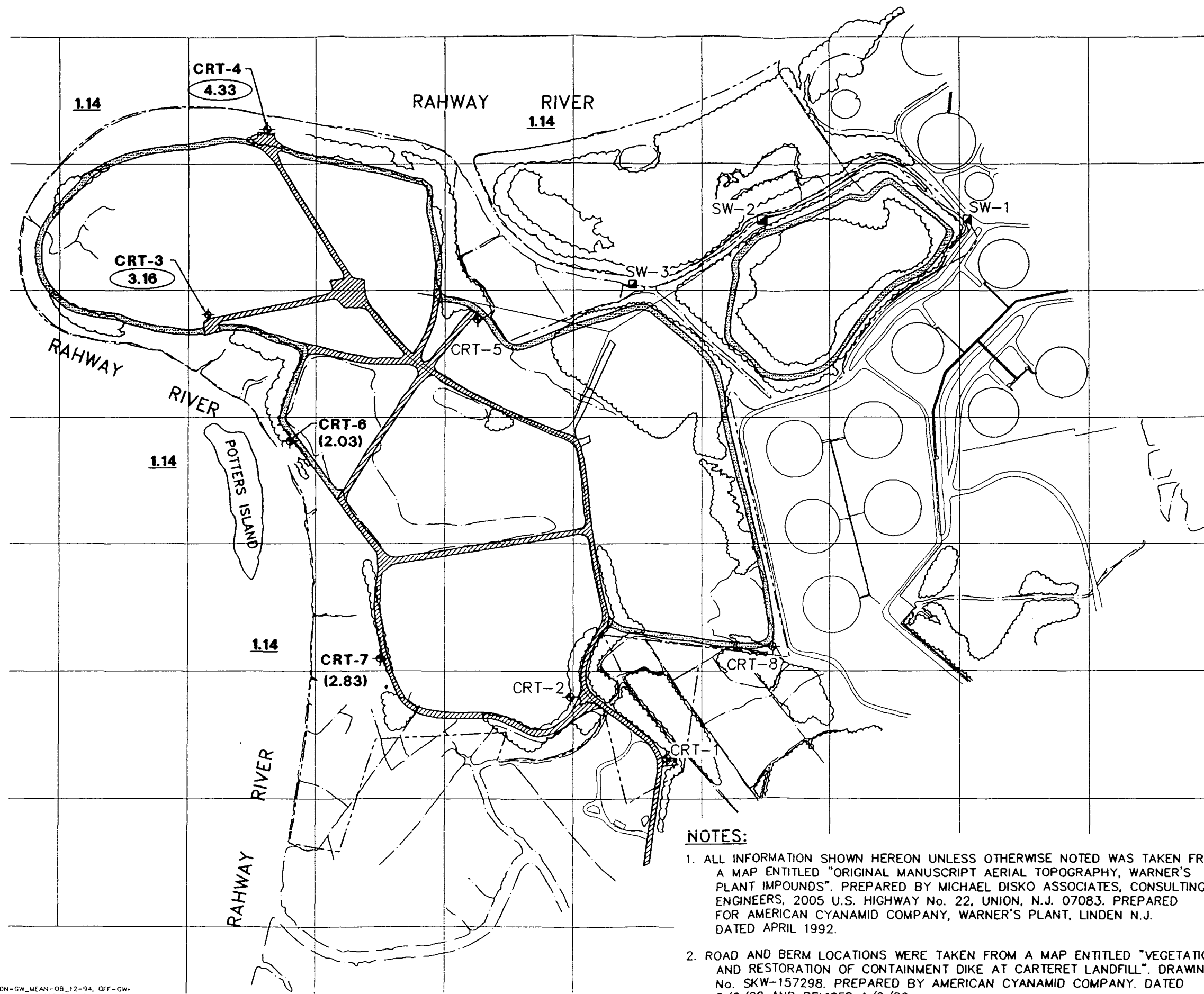
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**REMEDIAL ACTION PLAN ADDENDUM**  
**OVERBURDEN GROUND-WATER ELEVATIONS**  
7/13/94 (LOW TIDE)

FIGURE 2-4

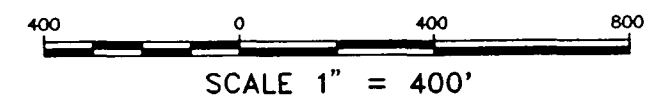
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# **LEGEND**

- CRT-8 EXISTING WELL CLUSTER LOCATION (APPROXIMATE)
- SW-1 SURFACE-WATER SAMPLING LOCATIONS (APPROXIMATE)
- ROAD
- BERM
- PROPERTY LINE LOCATION (APPROXIMATE)
- 3.16 DENOTES MEAN GROUND-WATER ELEVATION IN THE TIDAL MARSH DEPOSIT
- (2.83) DENOTES MEAN GROUND-WATER ELEVATION IN THE BASAL CLAYEY GRAVEL UNIT
- 1.14 DENOTES MEAN ELEVATION OF RAHWAY RIVER AS MEASURED CYTEC WARNERS PLANT



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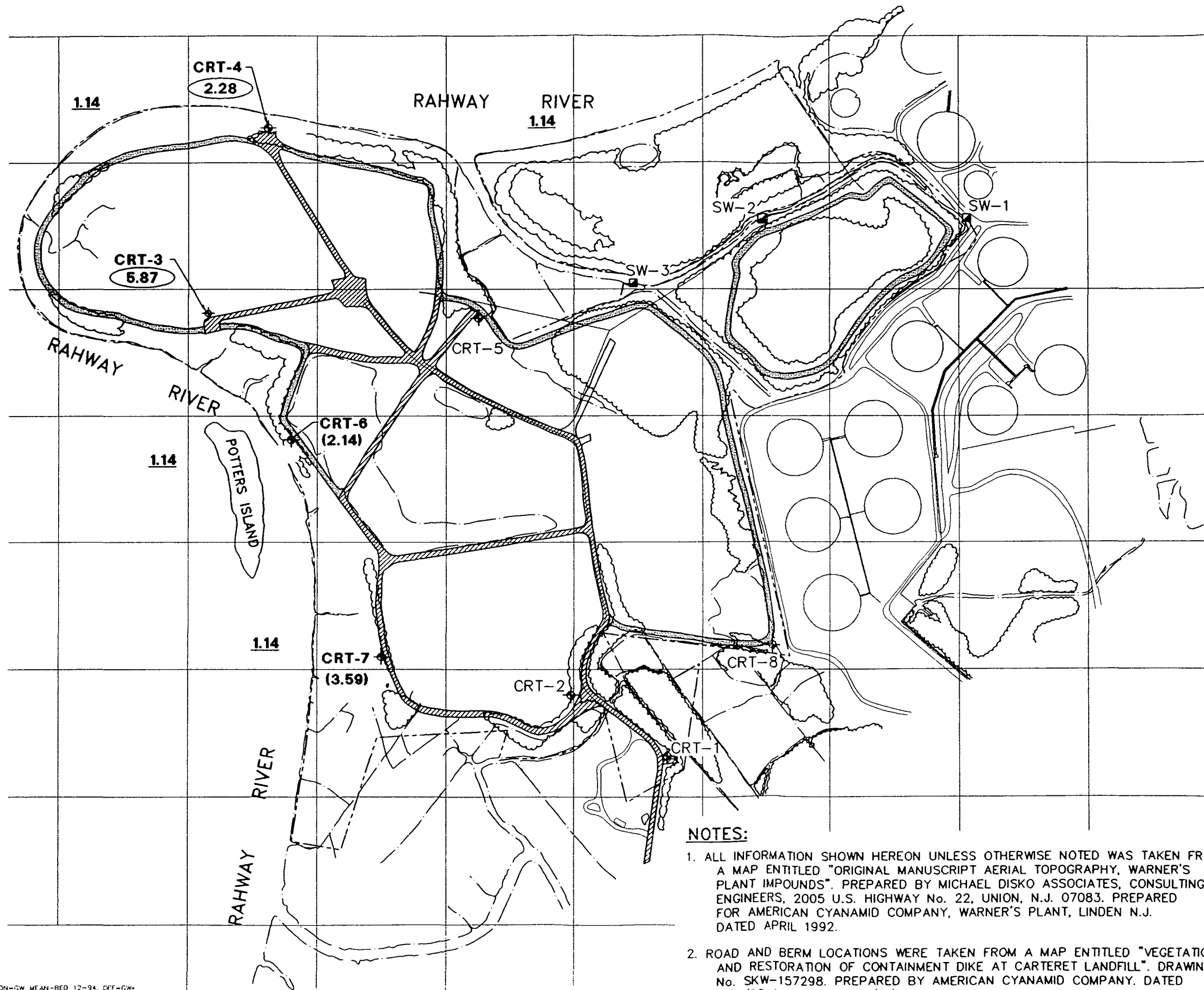
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## **REMEDIAL ACTION PLAN ADDENDUM**

**MEAN OVERBURDEN  
GROUND-WATER ELEVATIONS  
12/23/94 THRU 12/29/94**

FIGURE  
**4-5**



# **LEGEND**

- CRT-8 EXISTING WELL CLUSTER LOCATION (APPROXIMATE)
- SW-1 SURFACE-WATER SAMPLING LOCATIONS (APPROXIMATE)
- ROAD
- BERM
- PROPERTY LINE LOCATION (APPROXIMATE)
- DENOTES MEAN GROUND-WATER ELEVATION IN THE WEATHERED BEDROCK CONFINING UNIT
- DENOTES MEAN GROUND-WATER ELEVATION IN THE FIRST FRACTURED BEDROCK ZONE
- DENOTES MEAN ELEVATION OF RAHWAY RIVER AS MEASURED CYTEC WARNERS PLANT

400 0 400 800  
SCALE 1" = 400'



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REMEDIAL ACTION PLAN ADDENDUM

**MEAN BEDROCK  
GROUND-WATER ELEVATIONS**  
12/23/94 THRU 12/29/94

FIGURE  
**4-6**

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# TABLES



Table 1-1  
Summary of Analytical Results - Organics  
1981/1991 Residue Sampling  
Carteret Impoundments  
Carteret, New Jersey

Impoundment No.	1	1	2	2	2	2	3	3	3	3	3	4	4	4	4	5	5	6
Sample No.	S-1	S-2	S-1	S-2	S-5	S-6	S-1	S-2	S-1	S-2	S-3	S-9	S-9 Dup	S-10	S-11	S-7	S-7 Dup	S-8
Date	1981	1981	1981	1981	1991	1991	1981	1981	1991	1991	1991	1991	1991	1991	1991	1991	1991	1991
VOC (ug/kg)	nr	nr	nr	nr			nr	nr										
Acetone									20									
Carbon disulfide									1 JB									
Methylene chloride					18 JB	17 JB			8 B	6 BJ		19 JB	17 JB	29 B	26 B	2 JB	17 JB	22 B
Toluene									1 J									
SVOC (ug/kg)	nr	nr	nr	nr			nr	nr									na	
Acenaphthene					11 J													
Acenaphthylene									89 J									
Anthracene					18 J				1400	7 J								
Benzo(a)anthracene					38 J				2100	19 J	25 J							
Benzo(a)pyrene									1800									
Benzo(b)fluoranthene									1200									
Benzo(k)fluoranthene									1400									
Benzo(h)giperylene									1100									
Bis(2-ethylhexyl)phthalate					350 BJ	200 BJ			390 BJ	200 BJ	150 BJ	150 BJ	240 BJ	150 BJ	110 BJ	110 BJ		100 BJ
Butylbenzylphthalate						20 J			290 J		41 J		16 J					
Carbazole									470 J									
Chrysene					45 J				2600	21 J	30 J							
Dibenz(ah)anthracene									320 J									
Dibenzofuran					5 J				970	3 J								
Di-n-butyl phthalate					350 BJ	610 BJ			310 BJ	340 BJ	340 BJ	620 BJ	680 B	1000 B	640 BJ	410 BJ		430 BJ
Fluorene									1300									
Fluoranthene					90 J	22 J			4100	44 J	56 J							
Hexachlorobenzene					110 J	59 J				56 J	170 J							
Indeno(123cd)pyrene									590 J									
2-Methylnaphthene					12 J	11 J			1500	5 J	13 J			7 J				
Naphthalene									610 J	19 J	32 J							
Pentachlorophenol						41 J												
Phenanthrene					88 J	21 J			4400	56 J	31 J		15 J					
Pyrene					77 J	16 J			5100	34 J	44 J		17 J					
PCBs (ug/kg)	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	na	ND
Aroclor-1254									170 JP									
Pesticides	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND	ND	na	ND
alpha-Chlordane									12P									

Blank spaces indicate that analyte was not detected in sample

ND: not detected

nr: not reported; na: not analyzed

B: constituent detected at similar concentration in a blank sample

J: quantitative estimate

Table 1-2  
Summary of Analytical Results - Inorganics  
1981/1991 Residue Sampling  
Carteret Impoundments  
Carteret, New Jersey

Impoundment No.	1	1	2	2	2	2	3	3	3	3	3	4	4	4	4	5	5	5
Sample No.	S-1	S-2	S-1	S-2	S-5	S-6	S-1	S-2	S-1	S-2	S-3	S-9	S-9	S-10	S-11	S-7	S-7	S-8
Date	1981	1981	1981	1981	1991	1991	1981	1981	1991	1991	1991	1991	DUP	1991	1991	1991	DUP	1991
Inorganics (mg/kg)																		
Aluminum	3289	4057	110	76.8	27200	21400	5482	241	18400	27700	25800	8260	8870	15900	11700	10400	na	4450
Antimony	nr	nr	nr	nr	nr	9.9 B	nr	nr	3.1 B	3.8 B				8.8 B			na	5.9 B
Arsenic	nr	nr	nr	nr	3.5	3.5	nr	nr	8	8.9	3		1.6 B	2.2	1.2 B		na	
Barium	nr	nr	nr	nr	59.2	41.1 B	nr	nr	113	61.4	49.4	105	64.5	40.7 B	21.9 B	78.1	na	45
Beryllium	nr	nr	nr	nr	1 B	0.81 B	nr	nr	1.2	0.94	0.56 B	0.70 B	0.99	1.2	0.79 B	0.57 B	na	0.36 B
Calcium	nr	nr	nr	nr	208000	219000	nr	nr	8690	187000	195000	233000	264000	284000	218000	247000	na	194000
Cobalt	nr	nr	nr	nr	6.3 B	4.8 B	nr	nr	13.1	4.4 B	2.4 B	4.0 B	3.3 B	5.6 B	2.3 B		na	
Copper	4.75	6.33	2.67	2.5	15.5		3.33	3.33	127	3.2 B	10.7	4.9	11.7	11.1	1.5 B	2.2 B	na	
Chromium	10.6	11.7	3.43	3.78	25	18.8	5.49	3.43	24.7	27.1	26.1	12	16.7	25.1	16.4	12.9	na	6.7
Iron	nr	nr	nr	nr	10400	8850	nr	nr	18200	10700	9060	3070	3930	5880	2780	742	na	1360
Lead	16.7	13.9			40.9	28.9	nr	nr	174	44.6	32.3	21.4	30.4	25.9	12.6	18.3	na	10.7
Magnesium	nr	nr	nr	nr	12300	31500	nr	nr	4320	13900	15700	3270	4390	12600	2570	752 B	na	1650
Manganese	105	135	109	46.5	296	281	148	89	260	310	269	53.1	97.7	253	55.3	11.4	na	38 B
Mercury	nr	nr	nr	nr			nr	nr	0.19	0.69	0.36						na	
Nickel	nr	nr	nr	nr	13.3		nr	nr	27.5	4.0 B	6.6 B	6.7 B	6.5 B	6.7 B		7.2 B	na	
Potassium	nr	nr	nr	nr	774 B	473 B	nr	nr	2920	474 B		412 B	469 B	300 B		348 B	na	
Sodium	nr	nr	nr	nr	2750	11300	nr	nr	1980	2340	3600	12100	11800	1740	1200	2110	na	5210
Vanadium	nr	nr	nr	nr	30.2	31.5	nr	nr	29.6	38.3	30	17.4	30	31.3	19.6	12.3	na	9.9
Zinc	37.3	68.4	2.07	2.56	32	15.6	42.5	2.55	814	38.5	29.4	10.5	25.9	22.4	2.5 B	3.4 B	na	
Cyanide (mg/kg)																		
Total Cyanide	693	816	622	929	768	153	2198	2374	3.9	337	472	872	103	1020	68.7	9.7	na	403
Soluble Cyanide	180	33	35	29	na	na	425	416	na	na	na	na	na	na	na	na	na	na
Traditional Parameters																		
pH	7.5	7.8	9.3	9.2	na	na	7.6	8.1	na	na	na	na	na	na	na	na	na	na

Blank spaces indicate that analyte was not detected in sample

ND: not detected

nr: not reported; na: not analyzed

B: constituent detected at similar concentration in a blank sample

J: quantitative estimate

Fill Unit					Tidal Marsh Deposit	
General Description: Red-brown silt, sand and (glass, wood, and concrete), excepting impoundment					Description: Dark grey, silty clay	
Well	Unit Thickness (ft.)	Horizon Elevation		Bottom Elevation	Ground-Water Elevation	
		Top	Bottom			
CRT-1	0.0	6.70	6.70	6.70	Well screened across units	
CRT-2	5.0	6.70	1.70	-8.30	Well screened across units	
CRT-3	10.0	6.70	-3.30	-20.30	Well screened across units	
CRT-4	5.0	6.70	1.70	-23.30		4.00
CRT-5	10.0	6.70	-3.30	Well screened across units	-8.30	Well screened across units
CRT-6	3.0	7.95	4.95	-17.05	Confining unit, elevation not investigated	
CRT-7	3.0	4.51	1.51	-16.99	Confining unit, elevation not investigated	
CRT-8	4.0	6.91	2.91	-11.09	Confining unit, elevation not investigated	

Red-Brown Clay Unit					Shallow Bedrock	
General Description: Red-brown clay, silty and gravel, saturated					Description: Brown, light grey and green siltstone	
Well	Unit Thickness (ft.)	Horizon Elevation		Bottom Elevation	Ground-Water Elevation	
		Top	Bottom			
CRT-1	20.0	6.70	-13.30	-38.30		3.26
CRT-2	7.5	-8.30	-15.80	-43.30		3.46
CRT-3	8.0	-20.30	-28.30	-64.30		1.54
CRT-4	5.0	-23.30	-28.30	Not direct	-58.30	1.17
CRT-5	2.5	-8.30	-10.80	-28.30		3.14
CRT-6	6.0	-17.05	-23.05	-58.05		1.57
CRT-7	7.0	-16.99	-23.99	-83.99		3.31
CRT-8	13.5	-11.09	-24.59	-43.09		4.11

**Notes:**

1. fn.-cr. - fine to coarse.
2. Horizon and ground-water elevations are referenced to NGV
3. Ground-water elevations were obtained on 7/13/94.

TABLE 2-2  
SUMMARY OF GROUND-WATER ELEVATION MEASUREMENTS  
CARTERET IMPOUNDMENTS  
CYTEC INDUSTRIES, INC.  
CARTERET, NEW JERSEY

	Low Tide (Date July 13, 1994)		High Tide (Date July 14, 1994)		
Top of Casing Elevation [Feet Above Mean Sea Level (Ft. MSL)]	Depth to Ground Water (Ft. MSL)	Ground-Water Elevation (Ft. MSL)	Depth to Ground Water (Ft. MSL)	Ground-Water Elevation (Ft)	Well Name
7.86	4.60	3.26	4.57	3.29	CRT-1D
8.73	5.27	3.46	5.27	3.46	CRT-2D
11.67	10.13	1.54	8.78	2.89	CRT-3D
12.04	10.87	1.17	10.37	1.67	CRT-4D
7.47	4.33	3.14	4.13	3.34	CRT-5D
11.55	9.98	1.57	9.80	1.75	CRT-6D
8.31	5.00	3.31	5.19	3.12	CRT-7D
9.11	5.00	4.11	5.03	4.08	CRT-8D
7.96	4.79	3.17	4.75	3.21	CRT-1S
8.68	5.06	3.62	4.95	3.73	CRT-2S
11.81	9.55	2.26	8.07	3.74	CRT-3S
13.25	9.25	4.00	9.98	3.27	CRT-4S
7.17	4.15	3.02	4.02	3.15	CRT-5S
12.31	10.62	1.69	10.35	1.96	CRT-6S
7.28	4.78	2.50	4.63	2.65	CRT-7S
8.88	4.89	3.99	4.98	3.90	CRT-8S

**TABLE 2-3**  
**SUMMARY OF GROUND-WATER FLOW CALCULATIONS**  
**CARTERET IMPOUNDMENTS**  
**CARTERET, NEW JERSEY**

Well Cluster CRT-5 and CRT-6							
Tide Conditions	CRT-5 Water Level Elevation (Ft. MSL)	CRT-6 Water Level Elevation (Ft. MSL)	Distance Between Wells (Ft.)	Hydraulic Gradient (Ft./Ft.)	Hydraulic Conductivity (cm/sec)	Percent Porosity	Ground-Water Flow Velocity (ft./Day)
High Tide	3.15	1.96	870.96	1.37E-03	1.10	0.2	7.49E-03
Low Tide	3.02	1.69	870.66	1.53E-03	1.10	0.2	8.38E-03
Mean Value	3.09	1.83	870.66	1.45E-03	1.10	0.2	7.94E-03

Well Cluster CRT-2 and CRT-7							
Tide Conditions	CRT-2 Water Level Elevation (Ft. MSL)	CRT-7 Water Level Elevation (Ft. MSL)	Distance Between Wells (Ft.)	Hydraulic Gradient (Ft./Ft.)	Hydraulic Conductivity (cm/sec)	Percent Porosity	Ground-Water Flow Velocity (ft./Day)
High Tide	3.73	2.65	753.27	1.43E-03	1.10	0.2	7.86E-03
Low Tide	3.62	2.50	753.27	1.49E-03	1.10	0.2	8.15E-03
Mean Value	3.68	2.58	753.27	1.46E-03	1.10	0.2	8.01E-03

Mean Ground-Water Flow Velocity (ft./Day)      **7.97E-03**

TABLE 2-4  
 LABORATORY ANALYTICAL PROGRAM  
 CARTERET IMPOUNDMENTS SUPPLEMENTAL FIELD INVESTIGATION  
 CYTEC INDUSTRIES INC.  
 CARTERET, NEW JERSEY

MATRIX	ANALYSIS	PROPOSED ANALYTICAL METHOD	NUMBER OF FIELD SAMPLES	QUALITY ASSURANCE/QUALITY CONTROL SAMPLING					TOTAL NO. SAMPLES
				FIELD BLANKS	TRIP BLANKS	BLIND DUPLICATE	MS	MSD	
WATER	VOLATILES	USEPA METHOD 624	19	3	2	2	2	2	30
	INORGANICS (total and dissolved)	USEPA METHOD 200	19	6		4			29
	SULFATE	USEPA 375.3	19	3		2			24
	CHLORIDE	USEPA 325.3	19	3		2			24
	TOTAL / FREE CYANIDE	USEPA 600 SERIES	19	3		2			24
	TOTAL DISSOLVED SOLIDS	USEPA 160.1	19	3		2			24

**Table 2-5**  
**Summary of Analytical Results - QA/QC Samples**  
**Cytec Industries Inc. - Carteret Impoundments**  
**Carteret, NJ**

Sample Parameter (mg/l)	Trip Blanks		Field Blanks		
	TP 42670039 07/15/94	TP 42671011 07/15/94	FB71394 07/15/94	FB71494 07/15/94	FB71594 07/15/94
<b>Volatiles</b>					
Acetone	ND	0.006J	ND	ND	0.005J
<b>Water Quality Parameters</b>					
Chloride	ND	ND	0.0047	ND	0.0101
<b>Trace Metals (totals)</b>					
Aluminum	NA	NA	ND	ND	ND
Aluminum (dissolved)	NA	NA	ND	0.016 B	ND
Arsenic	NA	NA	0.0018 B N	ND	ND
Arsenic (dissolved)	NA	NA	0.0508 B N	ND	0.0012 B N
Beryllium	NA	NA	ND	ND	ND
Beryllium (dissolved)	NA	NA	ND	0.000055 B N	ND
Calcium	NA	NA	ND	ND	0.0375
Calcium (dissolved)	NA	NA	0.0613 B E	0.0584 B E	0.11 B
Chromium	NA	NA	ND	ND	ND
Chromium (dissolved)	NA	NA	0.002 B	0.0023 B	0.0059
Copper	NA	NA	ND	ND	ND
Copper (dissolved)	NA	NA	ND	0.0079 B	ND
Iron	NA	NA	ND	ND	0.0064 B NE
Iron (dissolved)	NA	NA	ND	0.0261 B E	0.0489 B NE
Lead	NA	NA	ND	ND	ND
Lead (dissolved)	NA	NA	0.0059 *	ND	ND
Magnesium	NA	NA	ND	ND	0.0244 B E
Magnesium (dissolved)	NA	NA	0.0353 B E	0.082 B	0.097 B E
Manganese	NA	NA	ND	ND	ND
Manganese (dissolved)	NA	NA	ND	0.0014 B E	0.002 B E
Nickel	NA	NA	0.0057 B	ND	ND
Nickel (dissolved)	NA	NA	ND	ND	ND
Potassium	NA	NA	ND	ND	ND
Potassium (dissolved)	NA	NA	ND	0.132 B NE	0.287 B E
Sodium	NA	NA	ND	0.148 B E	0.071 B E
Sodium (dissolved)	NA	NA	0.267 B	0.621	0.55 E
Thallium	NA	NA	ND	ND	ND
Thallium (dissolved)	NA	NA	ND	ND	0.0093 B
Zinc	NA	NA	0.0059 B	0.0063 B	ND
Zinc (dissolved)	NA	NA	0.0043 B	0.0097 B	ND

Notes:

NA: not analyzed

ND: not detected

B: result between EQL (Estimated Quantitation Limit) and IDL (Instrument Detection Limit)

E: exceeds calibration curve

J: result below detection limits, value is quantitative estimate

N: spiked sample recovery was outside control limits

\*: duplicate analysis outside control limits

TP (42670039) accompanied samples CRT-1S, CRT-1D, CRT-2S, CRT-2D, CRT-3S, CRT-4D, CRT-5S, CRT-5D, CRT-6S, CRT-6D, CRT-7S, CRT-7D, CRT-8S, CRT-8D

TP (42671011) accompanied samples SW-1, SW-2, SW-3

FB71394 for samples CRT-3S, CRT-3D, CRT-4S, CRT-4D, CRT-5S, CRT-5D

FB71494 for samples CRT-1S, CRT-1D, CRT-2S, CRT-2D, CRT-6S, CRT-6D, CRT-7S, CRT-7D, CR

FB71594 for samples SW-1, SW-2, SW-3

**TABLE 2-6**  
**SUMMARY OF SHALLOW GROUND-WATER QUALITY**  
**CYTEC INDUSTRIES INC. - CARTERET IMPOUNDMENTS**  
**CARTERET, NJ**

MONITORING WELL NO. SAMPLE DATE	CRT-1S 7/14/94	BD71494 7/14/94	CRT-2S 7/14/94	CRT-3S 7/13/94	CRT-4S 7/13/94	CRT-5S 7/13/94	CRT-6S 7/14/94	CRT-7S 7/14/94	CRT-8S 7/14/94	FB71394 7/13/94	FB71494 7/14/94	Trip Blank 7/14/94 (42670039)	PQL (4/5/93) (1)	GWQC CLASS II-A (4/5/93) (1)
<b>VOC (mg/l)</b>														
Acetone	0.063	0.053	ND	ND	0.029	ND	0.009J	0.026	0.009J	ND	ND	ND	NA	0.7
Benzene	0.045	0.046	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.001	0.0002
Carbon Disulfide	ND	ND	0.001J	ND	0.020	ND	ND	ND	ND	ND	ND	ND	NA	NA
Chlorobenzene	0.005	0.005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.004
Toluene	0.110	0.120	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.005	1.0
Xylenes ((total)	0.008	0.009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.040
<b>Conventional Parameters (mg/l)</b>														
Chloride	12300.0	4620.0	5110.0	1300.0	13700.0	7540.0	10300.0	9420.0	11600.0	4.7	ND	ND	2.0	250.0
Sulfate	144.0	95.8	690.0	231.0	1590.0	138.0	330.0	228.0	373.0	ND	ND	ND	5.0	250.0
TDS	9960.0	10200.0	8740.0	20900.0	26600.0	24800.0	19400.0	19500.0	21400.0	ND	ND	ND	10.0	500.0
<b>Cyanide (mg/l)</b>														
Cyanide ((free)	ND	ND	0.035	0.017	0.276	0.034	0.048	0.116	ND	ND	ND	ND	NA	NA
Cyanide ((total)	0.033	0.036	1.56	0.031	18.2	1.26	0.304	0.290	0.180	ND	ND	ND	0.040	0.2

Notes:

J - compound analyzed for and determined to be present in sample

ND - not detected

NA - not available

(1) NJDEP Ground Water Quality Criteria (NJAC 7:9-6)



TABLE 2-6 (CONTINUED)  
SUMMARY OF SHALLOW GROUND-WATER QUALITY  
INORGANICS  
CYTEC INDUSTRIES INC. - CARTERET IMPOUNDMENTS  
CARTERET, NJ

MONITORING WELL N SAMPLE DATE	CRT-1S 7/14/94	BD71494 7/14/94	CRT-2S 7/14/94	CRT-3S 7/13/94	CRT-4S 7/13/94	CRT-5S 7/13/94	CRT-6S 7/14/94	CRT-7S 7/14/94	CRT-8S 7/14/94	FB71394 7/13/94	FB71494 7/14/94	PQL (4/5/93) (1)	GWQC CLASS II-A (4/5/93) (1)
(mg/l)													
Trace Metals (Total)													
Aluminum	2.01 N	1.59 N	0.749 N	0.535 N	0.131 N	1.16 N	0.357 N	0.152 N	0.472 N	ND	ND	0.2	0.2
Aluminum (D)	0.566	0.266	0.276	0.033 B N	0.0453 B	0.0254 B	0.0742 B	0.130	0.056 B	ND	0.016 B	0.2	0.2
Antimony	ND	ND	ND	ND	0.0146 B	ND	ND	ND	ND	ND	ND	0.02	0.002
Antimony (D)	ND	ND N	ND	ND	0.0206 B N	ND	0.0206 B N	ND	0.0239 B N	ND	ND	0.02	0.002
Arsenic	ND	0.0027 B N	0.0032 B N	ND	0.0608 B N	ND	0.0248 B N	ND	0.045 B N	0.0018 B N	ND	0.008	0.00002
Arsenic (D)	ND	ND N	ND	ND	0.0338 B N	0.0212 B N	ND	ND	ND	0.0508 B N	ND	0.008	0.00002
Barium	1.06 NE	1.01 NE	0.171 NE	0.147 NE	0.0155 NE	0.1770 NE	0.31 NE	0.305 NE	0.205 NE	ND	ND	0.2	2.0
Barium (D)	0.963 NE	0.945 NE	0.181 NE	0.140 NE	0.0169 NE	0.1550 NE	0.3 NE	0.295 NE	0.214 NE	ND	ND	0.2	2.0
Beryllium	0.003	0.0024 B N	0.00013 B N	0.0001 B N	0.000065 B N	0.00011 B N	0.00006 B N	0.00006 B N	0.000075 B N	ND	ND	0.02	0.000008
Beryllium (D)	0.00057 B N	0.00025 B N	0.000075 B N	0.00005 B N	0.00006 B N	0.000065 B N	0.000065 B N	0.00028 B N	ND	ND	0.000055 B N	0.02	0.000008
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.004
Cadmium (D)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.004
Calcium	278.0	264	622.0	240.0	981.0	305.0	298.0	230.0	357.0	ND	ND	NA	NA
Calcium (D)	296.0 E	284	714.0 E	225.0	1210.0 E	284.0 E	300.0 E	230.0 E	366.0 E	0.0613 B E	0.0584 B E	NA	NA
Chromium	0.0022 B	ND	0.0041 B	ND	0.0049 B	ND	ND	0.0336	ND	ND	ND	0.01	0.1
Chromium (D)	0.0025 B	0.0014 B	0.0018 B	ND	0.0072	ND	ND	0.0178	ND	0.002 B	0.0023 B	0.01	0.1
Cobalt	0.003 B	0.0034 B	0.0032 B	ND	0.0398	ND	ND	ND	0.0068 B	ND	ND	NA	NA
Cobalt (D)	0.0046 B	0.0037 B	0.0032 B	ND	0.0441	ND	ND	ND	0.007 B	ND	ND	NA	NA
Copper	0.0034 B	0.0032 B	0.0067 B	ND	ND	ND	0.0067 B	ND	0.0089 B	ND	ND	1.0	1.0
Copper (D)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0079 B	1.0	1.0
Iron	112.0 E	96.4	3.17 E	0.999 E	4.28 E	1.86 E	3.9 E	4.3 E	1.74 E	ND	ND	0.1	0.3
Iron (D)	43.0 E	41 E	2.04 E	0.25 E	4.6 E	0.3440 E	3.16 E	0.489 E	0.909 E	ND	0.0261 B E	0.1	0.3
Lead	0.0068	0.0081	0.0045	0.0021 B	0.0018 B	0.0053	0.0039	0.003	0.0018 B	ND	ND	0.01	0.005
Lead (D)	ND	ND	ND	0.00057 B	ND	ND	0.0096 *	ND	ND	0.0059 *	ND	0.01	0.005
Magnesium	242.0	233	246.0	784.0	234.0	992.0	753.0	702.0	806.0	ND	ND	NA	NA
Magnesium (D)	251.0 E	244 E	262.0 E	751.0	219.0 E	1130.0 E	925.0 E	849.0 E	898.0 E	0.0353 B E	0.082 B E	NA	NA
Manganese	2.43 E	2.22 E	0.613 E	0.0426 E	0.0072 B E	0.0231 E	0.553 E	1.21 E	3.69 E	ND	ND	0.006	0.050
Manganese (D)	2.520 E	2.41 E	0.651 E	0.0377 E	0.0182 E	0.0115 E	0.436 E	1.2 E	3.77 E	ND	0.0014 B E	0.006	0.050
Mercury	0.00027 N	ND	0.00024 N	ND	ND	0.00031 N	ND	ND	0.00023 N	ND	ND	0.0005	0.002
Mercury (D)	ND	ND	ND	0.0002 N	ND	ND	ND	ND	ND	ND	ND	0.0005	0.002
Nickel	ND	ND	0.0062 B	ND	ND	ND	0.0057 B	ND	0.0058 B	0.0057 B	ND	0.01	0.1
Nickel (D)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	0.1
Potassium	44.7 NE	45.4 NE	21.7 NE	195.0 NE	129.0 NE	230.0 NE	175.0 NE	214.0 NE	152.0 NE	ND	ND	NA	NA
Potassium (D)	49.0 NE	49.6 NE	23.8 NE	188.0 NE	127.0 NE	224.0 NE	146.0 NE	186.0 NE	152.0 NE	ND	0.132 B NE	NA	NA
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	0.050
Selenium (D)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	0.050
Silver	0.0144	0.0121	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	NA
Silver (D)	0.0045 B	0.0042 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	NA
Sodium	2060.0 E	1950 E	2080.0 E	5060.0 E	5970.0 E	6230.0 E	5420.0 E	4750.0 E	5020.0 E	ND	0.148 B E	0.4	50.0
Sodium (D)	2160.0	2240	2190.0	4820.0 E	6570.0	6490.0	4770.0	5000.0	5260.0	0.267 B	0.621	0.4	50.0
Thallium	0.0086 B N	0.014 B N	ND	0.0071 B N	0.0138 B N	0.0110 B N	0.0059 B N	0.0173 B N	0.0102 B N	ND	ND	0.01	0.0005
Thallium (D)	0.0086 B N	ND	0.0092 B N	0.0129 B N	ND	ND	0.0094 B N	0.0103 B N	0.0087 B N	ND	ND	0.01	0.0005
Vanadium	0.0324	0.0303 N	ND	ND	ND	0.0076 B N	ND	ND	ND	ND	ND	NA	NA
Vanadium (D)	0.0112 B	0.0096 B	ND	ND	ND	0.0050 B	ND	0.0096 B	ND	ND	ND	NA	NA
Zinc	0.050	0.0173	0.0431	0.0432	0.0343	0.0193	0.0207	0.0453	0.0185	0.0059 B	0.0063 B	0.03	5.0
Zinc (D)	0.0023 B	0.0062 B	0.0233	ND	0.0086 B	ND	ND	ND	0.0035 B	0.0043 B	0.0097 B	0.03	5.0

Notes

D - dissolved

B - result is between the EQL (Estimated Quantitation Limit) and the IDL (Instrument Detection Limit)

E - serial dilution not within control limits

N - spiked sample recovery not within control limits

ND - not detected

\* - duplicate analysis not within control limits

NA - not available

(1) NJDEP Ground Water Quality Criteria (NJAC 7:9-6)

Table 2-7  
Summary of Shallow Ground-Water Quality: 1991 - 1992  
Cytec Industries Inc. - Carteret Impoundments  
Carteret, New Jersey

Monitoring Well No.	MW-13			MW-25			MW-35			MW-43			MW-65		
	Detection Frequency	Mean	Max	Detection Frequency	Mean	Max	Detection Frequency	Mean	Max	Detection Frequency	Mean	Max	Detection Frequency	Mean	Max
VOC (ug/l)															
Benzene	1 of 2	138	218							1 of 2	0.7	0.982			
Toluene	2 of 2	3570	4940												
SVOC (ug/l)				(2)											
Acenaphthene							1 of 2	2.08	3.02						
Isophorone	2 of 2	528	828												
Naphthalene	1 of 2	2.57	2.57												
Phenol	1 of 2	17.7	31.3							1 of 2	5.39	10.7			
PCBs															
Pesticides															
Inorganics (mg/l)															
Arsenic				1 of 2	0.018	0.018				1 of 2	0.017	0.017			
Antimony	1 of 2	0.048	0.068												
Barium	2 of 2	0.7	1.2				2 of 2	0.205	0.24	1 of 2	0.02	0.029	2 of 2	0.2	0.2
Beryllium	1 of 2	0.01	0.005												
Cadmium	1 of 2	13.6	28												
Copper	4 of 8	16	31	4 of 8	0.012	0.028	3 of 8	0.0095	0.018	4 of 8	0.012	0.02	4 of 8	0.012	0.024
Iron	8 of 8	274	371	8 of 8	2.39	5.2	4 of 8	0.233	1	8 of 8	8.51	11	4 of 8	0.328	0.49
Lead													1 of 8	0.005	0.005
Manganese	8 of 8	7.87	11.7	8 of 8	0.183	1.03	7 of 8	0.0587	0.17	1 of 8	0.005	0.05	1 of 8	0.005	0.005
Mercury	1 of 8	0.00012	0.00025				2 of 8	0.14	0.27	1 of 8	0.0008	0.0005	1 of 8	0.0001	0.0002
Silver							1 of 2	0.011	0.011						
Sodium	8 of 8	3888	4710	8 of 8	3495	5390	8 of 8	5698	8230	8 of 8	7200	8650	8 of 8	6568	7400
Thallium							1 of 2	0.001	0.001						
Zinc	8 of 8	0.092	0.16	4 of 8	0.029	0.061	5 of 8	0.038	0.075				4 of 8	0.027	0.062
Water Quality Parameters (mg/l)															
Chloride	8 of 8	8185	9430	8 of 8	7088	11200	8 of 8	10375	12000	8 of 8	14319	17100	8 of 8	14397	18300
Fluoride	2 of 2	0.87	1.2	2 of 2	7.9	7.9	2 of 2	0.38	0.4	2 of 2	4.78	4.8	2 of 2	0.39	0.4
Nitrate	1 of 8	0.2	0.2	1 of 8	0.1	0.1	3 of 8	0.31	1.6	1 of 8	0.08	0.1	2 of 8	0.1	0.1
Sulfate	8 of 8	158	302	8 of 8	2389	3620	8 of 8	284	808	8 of 8	3874	4000	8 of 8	365	1180
Ammonia	8 of 8	5.78	8	8 of 8	75.3	140	8 of 8	24.5	35	8 of 8	310	440	8 of 8	22.3	37
pH (1)	8 of 8	5.78	5.43	8 of 8	7.87	6.81	8 of 8	8.75	6.55	8 of 8	8.23	7.01	8 of 8	7.14	6.8
Cyanide (mg/l)															
Cyanide (total)	8 of 8	0.059	0.081	8 of 8	11.8	19.8	8 of 8	0.204	0.288	8 of 8	84.5	104	8 of 8	1.98	5.64
Cyanide (free)	nr			3 of 8	0.052	0.12	nr			7 of 8	0.2	0.224	nr		

Blank spaces indicate that analyte was not detected in sample

nr: not reported

(1): Maximum pH is lowest pH measured

(2): Incredible semivolatile results: compounds detected at low ug/l in January 1991; not detected in other quarters before or after January 1991

**Table 2-8**  
**Summary of Deep Ground-Water Quality: 1991 - 1992**  
**Cytex Industries Inc. - Carteret Impoundments**  
**Carteret, New Jersey**

Monitoring Well No.	MW-1D			MW-2D			MW-3D			MW-4D			MW-5D		
	Detection Frequency	Mean	Max	Detection Frequency	Mean	Max	Detection Frequency	Mean	Max	Detection Frequency	Mean	Max	Detection Frequency	Mean	Max
VOIC (ug/l)															
Benzene													1 of 2	2.66	4.88
Ethylbenzene													1 of 2	1.36	2.02
Methylene Chloride							2 of 2	0.966	0.966	1 of 2	0.567	0.854	2 of 2	1.02	1.03
Toluene													1 of 2	2.26	3.92
SVOC (ug/l)															
Acenaphthene													1 of 2	1.45	1.94
Fluorene													1 of 2	1.64	2.33
Naphthalene													1 of 2	2.15	3.49
Inorganics (mg/l)															
Barium	2 of 2	0.044	0.06	1 of 2	0.0205	0.031	1 of 2	0.041	0.072	2 of 2	0.053	0.056	2 of 2	0.15	0.18
Beryllium	1 of 2	0.0008	0.0011	4 of 8	0.012	0.023									
Copper	3 of 8	0.01463	0.036				4 of 8	0.0149	0.03	4 of 8	0.0176	0.037	3 of 8	0.01138	0.031
Iron	6 of 8	96.58	30.4	7 of 8	3.62	12	8 of 8	0.0049	12	7 of 8	8.17	24.1	5 of 8	0.748	2.6
Lead	1 of 8	0.00337	0.0052	1 of 8	0.00338	0.0078	8 of 8	0.35	0.4	2 of 8	0.00143	0.0077	1 of 8	0.00542	0.02
Manganese	8 of 8	3.4855	4.88	8 of 8	1.03	1.53	8 of 8	5540	6070	8 of 8	0.726	0.866	8 of 8	0.925	1.29
Mercury										1 of 8	0.00013	0.00032			
Sodium	8 of 8	6630.125	35200	8 of 8	4733.8	5660	1 of 2	0.00058	0.000669	8 of 8	4988.8	5230	8 of 8	5052.6	6240
Thallium										1 of 2	0.195	0.195	1 of 2	0.000788	0.000788
Zinc	5 of 8	0.086	0.04388	4 of 8	0.028	0.07	4 of 8	0.0331	0.067	5 of 8	0.0414	0.089	5 of 8	0.03	0.072
Water Quality Parameters (mg/l)															
Chloride	8 of 8	7313.75	13180	8 of 8	9721	12840	8 of 8	1345	1638	8 of 8	12468.8	13800	8 of 8	10623.3	14370
Fluoride				2 of 8	0.17	0.2	2 of 2	0.24	0.3	2 of 2	0.255	0.31	2 of 2	0.56	0.7
Nitrate	3 of 8	0.07	0.2	1 of 8	0.069	0.2				3 of 8	0.13	0.6	1 of 8	0.056	0.1
Sulfate	8 of 8	549.66	905	8 of 8	1481.6	3910	8 of 8	1277	1390	8 of 8	1071.5	1310	8 of 8	730	1120
Ammonia	7 of 8	1.03	1.7	8 of 8	27.4	140	8 of 8	9.49	12	8 of 8	10.06	23	8 of 8	9.9	15
pH (1)	8 of 8	6.61	6.32	8 of 8	6.95	6.63	8 of 8	6.66	6.45	8 of 8	6.62	6.34	8 of 8	7.16	6.83
Cyanide (mg/l)															
Cyanide (total)				8 of 8	2.38	10.9	4 of 8	0.028	0.054	8 of 8	2.09	5.38	8 of 8	5.24	20.4

Blank spaces indicate that analyte was not detected in sample

(1) Maximum pH is lowest pH measured

**TABLE 2-9**  
**SUMMARY OF DEEP GROUND-WATER QUALITY**  
**CYTEC INDUSTRIES INC. - CARTERET IMPOUNDMENTS**  
**CARTERET, NJ**

MONITORING WELL NO. SAMPLE DATE	CRT-1D 7/14/94	CRT-2D 7/14/94	CRT-3D 7/13/94	CRT-4D 7/13/94	CRT-5D 7/13/94	CRT-6D 7/14/94	CRT-7D 7/14/94	CRT-8D 7/14/94	Trip Blank 7/14/94 (42670039)	FB71394 7/13/94	FB71494 7/14/94	PQL (4/5/93) (1)	GWQC CLASS II-A (4/5/93) (1)
<b>VOC (mg/l)</b>													
Acetone	ND	ND	ND	ND	ND	0.007J	0.006J	0.008J	ND	ND	ND	NA	0.7
Carbon Disulfide	ND	ND	ND	0.043	0.002J	ND	ND	ND	ND	ND	ND	NA	NA
<b>Conventional Parameters (mg/l)</b>													
Chloride	9680.0	10600.0	1400.0	8040.0	10200.0	10600.0	9510.0	13000.0	ND	4.7	ND	2.0	250.0
Sulfate	381.0	852.0	720.0	1060.0	315.0	426.0	366.0	249.0	ND	ND	ND	5.0	250.0
TDS	22400.0	19500.0	25600.0	15800.0	21700.0	21600.0	27200.0	20200.0	ND	ND	ND	10.0	500.0
<b>Cyanide (mg/l)</b>													
Cyanide: (free)	ND	0.013	ND	0.098	0.053	ND	ND	ND	ND	ND	ND	NA	NA
Cyanide: (total)	ND	0.133	0.075	23.8	1.540	0.025	ND	ND	ND	ND	ND	0.040	0.2

**Notes:**

J - compound analyzed for and determined to be present in sample

ND - not detected

NA - not available

(1) NJDEP Ground Water Quality Criteria And Practical Quantitation Limits (NJAC 7:9-6)

TABLE 2-9 (CONTINUED)  
SUMMARY OF DEEP GROUND-WATER QUALITY  
INORGANICS  
CYTEC INDUSTRIES INC. - CARTERET IMPOUNDMENTS  
CARTERET, NJ

MONITORING WELL SAMPLE DATE	CRT-1D 7/14/94	CRT-2D 7/14/94	CRT-3D 7/13/94	CRT-4D 7/13/94	CRT-5D 7/13/94	CRT-6D 7/13/94	CRT-7D 7/14/94	CRT-8D 7/14/94	FB71394 7/13/94	FB71494 7/14/94	PQL (4/5/93) (1)	GWQC CLASS II-A (4/5/93) (1)
mg/l												
Inorganics (Total)												
Aluminum	0.113 N	0.152	1.78 N	0.248 N	0.0818 B N	0.0735 B N	0.745 N	0.0645 B N	ND	ND	0.2	0.2
Aluminum (D)	0.140	0.0352 B	0.106	0.103	0.102	0.0971 B	0.194	0.102	ND	0.016 B	0.2	0.2
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.02	0.002
Antimony (D)	ND	ND	ND	ND	ND	0.0191 B N	ND	0.0165 B N	ND	ND	0.02	0.002
Arsenic	ND	ND	0.0316 B N	0.0091 B N	0.0512 B N	ND	ND	ND	0.0018 B N	ND	0.008	0.00002
Arsenic (D)	0.0448 B N	ND	ND	0.0738 B N	0.0484 B N	ND	0.0338 B N	0.0224 B N	0.0508 B N	ND	0.008	0.00002
Barium	0.0506 NE	0.0621 NE	0.0496 NE	0.12 NE	0.299 NE	0.0337 NE	0.058 NE	0.0499 NE	ND	ND	0.2	2.0
Barium (D)	0.0397 NE	0.0558 NE	0.0365 NE	0.125 NE	0.161 NE	0.0331 NE	0.0505 NE	0.0487 NE	ND	ND	0.2	2.0
Beryllium	0.00047 B N	0.0001 B N	0.00064 B N	0.00028 B N	0.00007 B N	0.00016 B N	0.00039 B N	0.000075 B N	ND	ND	0.02	0.000008
Beryllium (D)	0.0003 B N	0.000075 B N	0.00016 B N	0.0002 B N	0.000055 B N	0.00018 B N	0.00053 B N	0.000055 B N	ND	0.000055 B N	0.02	0.000008
Cadmium	0.0022 B	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.004
Cadmium (D)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	0.004
Calcium	2180.0	624.0	1540.0	703.0	279.0	921.0	1640.0	337.0	ND	ND	NA	NA
Calcium (D)	2460.0 E	690.0 E	1750.0 E	758.0 E	268.0	1100.0 E	1750.0 E	328.0 E	0.0613 B E	0.0584 B E	NA	NA
Chromium	ND	ND	0.0013 B	ND	ND	ND	ND	ND	ND	ND	0.01	0.1
Chromium (D)	ND	ND	ND	0.0024 B	ND	ND	ND	ND	0.002 B	0.0023 B	0.01	0.1
Cobalt	ND	ND	0.0037 B	0.0282	ND	ND	ND	ND	ND	ND	NA	NA
Cobalt (D)	ND	ND	ND	0.0295	ND	ND	ND	ND	ND	ND	NA	NA
Copper	0.0186	0.0041 B	0.0087 B	ND	0.0032 B	ND	0.0022 B	ND	ND	ND	1.0	1.0
Copper (D)	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0079 B	1.0	1.0
Iron	56.0 E	16.0 E	19.0 E	4.82 E	53.4 E	7.57 E	33.0 E	0.933 E	ND	ND	0.1	0.3
Iron (D)	0.564 E	5.22 E	9.63 E	0.917 E	13.1 E	7.52 E	29.0 E	0.399 E	ND	0.0261 B E	0.1	0.3
Lead	0.0056	0.0042	0.019 S	0.0024 B	0.00075 B	0.0026 B	0.0039	0.0014 B	ND	ND	0.01	0.005
Lead (D)	ND	ND	0.0011 B *	ND	ND	0.0012 B *	ND	ND *	0.0059 *	ND	0.01	NA
Magnesium	597.0	669.0	844.0	345.0	833.0	735.0	641.0	723.0	ND	ND	NA	NA
Magnesium (D)	665.0 E	747.0 E	937.0 E	360.0 E	966.0 E	880.0 E	674.0 E	760.0 E	0.0353 B E	0.082 B E	NA	NA
Manganese	2.620 E	0.836 E	0.598 E	0.0962 E	1.05 E	0.631 E	0.877 E	0.522 E	ND	ND	0.006	0.050
Manganese (D)	1.210 E	0.597 E	0.288 E	0.0732 E	0.954 E	0.656 E	0.831 E	0.516 E	ND	0.0014 B E	0.006	0.050
Mercury	0.00033 N	0.00034 N	ND	ND	ND	ND	ND	ND	ND	ND	0.0005	0.002
Mercury (D)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.0005	NA
Nickel	ND	ND	0.0131 B	ND	ND	ND	ND	ND	0.0057 B	ND	0.01	0.1
Nickel (D)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	0.1
Potassium	17.8 NE	75.2 NE	29.0 NE	147.0 NE	197.0 NE	41.6 NE	19.9 NE	75.6 NE	ND	ND	NA	NA
Potassium (D)	19.9 NE	124.0 NE	29.9 NE	147.0 NE	203.0 NE	47.1 NE	20.5 NE	125.0 NE	ND	0.132 B NE	NA	NA
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.01	0.050
Selenium (D)	ND	ND	ND	ND	ND	ND	ND	ND N	ND	ND	0.01	0.050
Silver	0.0054	ND	ND	ND	0.0037 B	ND	0.0027 B	ND	ND	ND	0.002	NA
Silver (D)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.002	NA
Sodium	3160.0 E	4460.0 E	4780.0 E	3580.0 E	5490.0 E	3820.0 E	3710.0 E	5350.0 E	ND	0.148 B E	0.4	50.0
Sodium (D)	3000.0	4730.0	4960.0	3670.0	6030.0	4300.0	3470.0	5460.0	0.267 B	0.621	0.4	50.0
Thallium	0.0078 B N	0.0159 B N	0.011 B N	0.01 B N	0.0086 B N	0.0108 B N	0.012 B N	0.0053 B N	ND	ND	0.01	0.0005
Thallium (D)	0.0101 B N	0.0139 B N	ND	ND	ND	ND	ND	0.0104 B N	ND	ND	0.01	0.0005
Vanadium	0.0081 B N	ND	0.006 B N	ND	0.0095 B N	ND	0.0035 B N	ND	ND	ND	NA	NA
Vanadium (D)	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Zinc	0.168	0.0401	0.0656	0.0253	0.087	0.0071 B	ND	0.0314	0.0059 B	0.0063 B	0.03	5.0
Zinc (D)	0.0483	ND	ND	0.0106	ND	0.0203	ND	0.0379	0.0043 B	0.0097 B	0.03	5.0

Notes

D - dissolved

B - result is between the EQL (Estimated Quantitation Limit) and the IDL (Instrument Detection Limit)

E - serial dilution not within control limits

N - spiked sample recovery not within control limits

ND - not detected

NA - not available

S - reported value was determined by the Method of Standard Additions (MSA)

(1) NJDEP Ground Water Quality Criteria (NJAC 7:9-6)

**TABLE 2-10**  
**SUMMARY OF SURFACE WATER QUALITY**  
**CYTEC INDUSTRIES INC. - CARTERET IMPOUNDMENTS**  
**CARTERET, NJ**

SURFACE WATER LOCATION SAMPLE DATE	SW-1 7/15/94	SW-2 7/15/94	SW-BD (SW-2) 7/15/94	SW-3 7/15/94	Trip Blank (42671011) 7/15/94	FB71594 7/15/94	SE3 SURFACE WATER QUALITY STANDARDS (1)			
							Human Health	Acute Toxicity	Chronic Toxicity	RQLs
<b>VOCs</b>										
Acetone	ND	ND	ND	ND	0.006J	0.005J	NA	NA	NA	NA
<b>Conventional Parameters (mg/l)</b>										
Chloride	14700.0	15200.0	13200.0	27200.0	ND	10.1	NA	NA	NA	NA
Sulfate	954.0	1020.0	1700.0	1020.0	ND	ND	NA	NA	NA	NA
TDS	18900.0	21300.0	20800.0	21600.0	ND	ND	NA	NA	NA	NA
<b>Cyanide (mg/l)</b>										
Cyanide (free)	0.026	ND	ND	ND	ND	ND	220.0	0.001	0.001	NA
Cyanide (total)	0.142	0.127	0.173	ND	ND	ND	NA	NA	NA	0.04

Notes:

**No VOCs detected using EPA Method 624**

J: compound analyzed for and determined to be present in the sample. Concentration is estimated value which is less than minimum detection limit (MDL) but greater than zero.

ND - not detected

NA - not available

(1) SWQS (surface water quality standards) from NJAC 7:9B-1:14. RQLs (Recommended Quantitation Limit) used as standard where RQL is greater than SWQS

(H. Shah, NJDEP, personal communication, 09/20/94)

**TABLE 2-10 (CONTINUED)**  
**SUMMARY OF SURFACE WATER QUALITY**  
**INORGANICS**  
**CYTEC INDUSTRIES INC. - CARTERET IMPOUNDMENTS**  
**CARTERET, NJ**

SURFACE WATER LOCATION SAMPLE DATE	SW-1	SW-2	SW-BD (SW-2)	SW-3	FB71594	SE3 SURFACE WATER QUALITY STANDARDS (1)			RQLs
	7/15/94	7/15/94	7/15/94	7/15/94	7/15/94	Human Health (12/20/93)	Acute Toxicity (12/20/93)	Chronic Toxicity (12/20/93)	
<b>mg/l</b>									
<b>Inorganics (Total)</b>									
Aluminum	0.276	0.163	0.141	0.0849 B	ND	NA	NA	NA	NA
Aluminum (D)	0.0386 B	0.0183 B	0.0185 B	0.0376 B	ND	NA	NA	NA	NA
Antimony	0.0114 B N	0.0392 N	0.0256 N	ND	ND	4.3	NA	NA	0.02
Antimony (D)	ND	ND	ND	ND	ND	4.3	NA	NA	NA
Arsenic	ND	ND	ND	ND	ND	0.000136	NA	NA	0.008
Arsenic (D)	0.0512 N	ND	ND	0.0272 N	0.0012 B N	0.000136	NA	NA	NA
Barium	0.0495 NE	0.022 NE	0.0223 NE	0.0165 NE	ND	NA	NA	NA	0.02
Barium (D)	0.0423 NE	0.0209 NE	0.0198 NE	0.0172 NE	ND	NA	NA	NA	NA
Beryllium	ND	0.000065 B	ND	ND	ND	R	R	R	0.02
Beryllium (D)	ND	ND	ND	ND	ND	NA	NA	NA	NA
Cadmium	ND	ND	ND	ND	ND	NA	NA	NA	0.004
Cadmium (D)	ND	ND	ND	ND	ND	NA	NA	NA	NA
Calcium	201.0	204.0	202.0	184.0	0.0375 B	NA	NA	NA	NA
Calcium (D)	173.0	199.0	189.0	193.0	0.11 B	NA	NA	NA	NA
Chromium	ND	ND	ND	ND	ND	3.23	NA	NA	0.01
Chromium (D)	ND	ND	ND	ND	0.0059	NA	NA	NA	NA
Cobalt	ND	ND	ND	ND	ND	NA	NA	NA	NA
Cobalt (D)	ND	ND	ND	ND	ND	NA	NA	NA	NA
Copper	0.0063 B	0.0045 B	0.0037 B	0.0026 B	ND	R	R	R	0.01
Copper (D)	0.0044 B	0.0124	ND	0.0019 B	ND	NA	NA	NA	NA
Iron	0.781 NE	0.43 NE	0.41 NE	0.288 NE	0.0064 B NE	NA	NA	NA	NA
Iron (D)	0.184 NE	0.138 NE	0.155 NE	0.258 NE	0.0489 B NE	NA	NA	NA	NA
Lead	0.0024 B N	ND	ND	ND	ND	NA	NA	NA	0.01
Lead (L)	ND	ND	ND	ND	ND	NA	NA	NA	NA
Magnesium	656.0 E	717.0 E	721.0 E	636.0 E	0.0244 B E	NA	NA	NA	NA
Magnesium (D)	572.0 E	712.0 E	683.0	714.0 E	0.097 B E	NA	NA	NA	NA
Manganese	0.152 E	0.102 E	0.095 E	0.0788 E	ND	0.1	NA	NA	NA
Manganese (D)	0.130 E	0.0935 E	0.0916 E	0.0831 E	0.002 B E	NA	NA	NA	NA
Mercury	ND	ND	ND	ND	ND	0.000146	NA	NA	0.001
Mercury (D)	ND	ND	ND	ND	ND	NA	NA	NA	NA
Nickel	ND	ND	ND	ND	ND	3.9	NA	NA	0.01
Nickel (D)	ND	ND	ND	ND	ND	NA	NA	NA	NA
Potassium	167.0 E	183.0 E	190.0 E	164.0 E	ND	NA	NA	NA	NA
Potassium (D)	151.0 E	184.0 E	175.0	186.0 E	0.287 B E	NA	NA	NA	NA
Selenium	ND N	ND	ND	ND	ND	NA	NA	NA	0.01
Selenium (D)	ND	ND	ND	ND	ND	NA	NA	NA	NA
Silver	ND	ND	ND	ND	ND	NA	NA	NA	0.002
Silver (D)	ND	ND	ND	ND	ND	NA	NA	NA	NA
Sodium	4730.0	5220.0 E	5240.0 E	4660.0 E	0.071 B E	NA	NA	NA	NA
Sodium (D)	4470.0 E	5360.0 E	4910.0 E	5200.0 E	0.55 E	NA	NA	NA	NA
Thallium	0.0101	0.0143	0.0119	ND	ND	0.00622	NA	NA	0.01
Thallium (D)	0.0113	ND	ND	0.0099 B	0.0093 B	NA	NA	NA	NA
Vanadium	ND	ND	ND	ND	ND	NA	NA	NA	NA
Vanadium (D)	ND	ND	ND	ND	ND	NA	NA	NA	NA
Zinc	0.033	0.119 *	ND	ND	ND	R	R	R	0.03
Zinc (D)	ND	ND	0.028 *	0.0098 B *	ND	NA	NA	NA	NA

**Notes:**

(D)-dissolved

\* - duplicate analysis is not within control limits

B - result between the EQL (Estimated Quantitation Limit) and IDL (Instrument Detection Limit)

E - serial dilution not within control limits

N - spiked sample recovery not within control limits

ND - not detected

R - reserved

(1) SWQS (surface water quality standards) from NJAC 7:9B-1:14. RQLs (Recommended Quantitation Level)

used as standard where RQL is greater than SWQS

(H. Shah, NJDEP, personal communication, 09/20/94)

**TABLE 3-1**  
**NJDEP Ground-Water Classification Criteria**  
CYTEC INDUSTRIES INC. - CARTERET IMPOUNDMENTS  
CARTERET, NEW JERSEY  
REMEDIAL ACTION PLAN ADDENDUM

**Class I - Ground Water of Special Ecological Significance**

- Class I-A: exceptional ecological areas designated by NJDEP in NJAC 7:9-6.5(d)1, or through rulemaking demonstrating that ground water contributes:
  - to surface water in FW-1 watersheds; or
  - to land surface or surface water in areas of exceptional ecological value, as defined in NJAC 7:9-6.5(d)1ii.
- Class I-PL: ground water in Cohansey and Kirkwood formations located within Pinelands area as designated by the Pinelands Protection Act, except Class I-A areas.

**Class II - Ground Water for Potable Water Supply**

- Class II-A: all ground water, except areas designated Class I, II-B, or III.
- Class II-B: areas established by rulemaking petition demonstrating:
  - ground water exceeds one or more ground-water criteria (potable standards) owing to past discharges;
  - restoration is technologically impracticable;
  - essentially no community supply wells or zone of contribution within area now or next 25 years;
  - no risk of constituent migration to I, II-A or III-A areas;
  - natural attenuation can restore quality to II-A criteria

**Class III - Ground Water With Uses Other Than Potable Water Supply**

- Unsuitable for potable use due to natural hydrogeology or ground-water quality
- Class III-A: aquitards protected as conveyance to other classification areas.
- Includes portions of Navesink and Hornerstown Formations; aquitards within the PRM and Kirkwood aquifer systems; and portions of glacial moraine and lake deposits. These and other III-A areas share following characteristics:
  - average 50 feet thickness in III-A area;
  - hydraulic conductivity of 0.1 foot/day or less; and
  - areal extent of 100 acres or greater.
- Class III-B: ground water naturally contains total dissolved solids (TDS) above 5,000 mg/l, or chloride above 3,000 mg/l, or other natural factor prohibiting potable use.



**Carteret, New Jersey**

Quarter	Jul-87	Oct-87	Jan-88	Apr-88	Jul-88	Oct-88	Jan-89	Apr-89	Jul-89	Oct-89	Jan-90	Apr-90	Jul-90	Oct-90	Jan-91	Apr-91	Jul-91	Oct-91	Jan-92	Apr-92	Jul-92	Oct-92	Min	Max	Mean
Units	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Shallow Monitoring Wells																									
MW-1S																									
Chloride	5830	5780	6530	4400	4350	5250	4810	6530	6820	7280	8550	5630	5680	4880	6220	8800	5070	1030	9020	7650	9430	8530	1030	9430	8185
TDS	11900	16600	13900	7900	8800	9490	10800	13200	13800	14200	11100	10800	10900	12000	10200	17200	17700	18400	15700	12000	17000	14000	7900	18400	13072
MW-2S																									
Chloride	9460	9770	8110	7890	9160	8740	7990	8100	7860	7550	7750	7200	6821	7270	6240	4820	11200	67.8	6390	6790	3040	3690	67.6	11200	7086
TDS	20700	22900	18100	17400	19700	20200	16700	17800	18200	18700	17300	16400	16300	16500	14900	14000	21300	15220	15200	15000	7800	10100	7800	22900	16746
MW-3S																									
Chloride	11800	12000	12500	6230	10300	11130	11290	11400	1200	11670	10920	12300	10400	12200	8120	7990	9480	9630	11400	12200	11400	12700	1200	12700	10375
TDS	20900	22200	20400	13100	19000	21600	25100	21100	21800	21800	21100	21600	21000	21400	15500	15000	18900	19200	19600	21000	20000	21000	13100	25100	20014
MW-4S																									
Chloride	16300	16100	17100	15300	14900	13050	15110	14200	13700	13600	14500	13800	12100	11400	14100	13970	14200	13700	14000	14700	13600	15600	11400	17100	14319
TDS	28100	29800	27900	27100	27000	27400	26200	21900	26200	26800	26800	25900	26200	28000	26300	26800	27600	25900	26900	27000	26000	27000	21900	29800	26755
MW-5S																									
Chloride	9790	14500	14900	14500	14100	14470	12290	13600	15300	13530	14200	13900	14500	14900	14100	13880	14400	17270	18300	14500	14600	15200	9790	18300	14397
TDS	25000	26300	23900	24000	24400	25300	22800	24800	23900	25300	24600	26300	24800	22100	24900	25000	24800	24500	23800	25000	24000	25000	22100	26300	24559
Bedrock Monitoring Wells																									
MW-1D																									
Chloride	9800	9280	9400	9290	9980	9930	10050	10100	10100	9920	10000	10700	9730	9310	10200	7450	9380	13180	10200	3870	1510	2720	1510	13180	8913
TDS	26800	24900	19700	20600	23000	23700	20700	18000	25100	23300	19400	25700	24200	19400	21000	20400	21300	20060	21200	7100	2600	5500	2600	26600	19748
MW-2D																									
Chloride	10100	11000	10900	10000	7470	6950	8530	8480	10880	8960	6640	5480	1430	3410	11400	9220	6620	12840	11200	9770	8590	8130	1430	12840	8544
TDS	21900	22900	19420	18900	15500	19800	17800	21100	20300	17800	16700	10800	10000	8200	19800	17900	15800	17150	19900	17000	16000	16000	8200	22900	17294
MW-3D																									
Chloride	7750	11100	11300	12200	10500	11960	11010	4990	12300	12570	13200	12700	12900	13100	12900	13210	13000	16380	13000	12300	13500	13300	4990	16380	12053
TDS	15100	24800	20900	21900	24000	23400	21500	12500	23000	24400	23900	24400	24900	23000	23500	24100	23700	22920	23100	23000	27000	23000	12500	27000	22637
MW-4D																									
Chloride	11800	11800	11300	12200	12300	12200	11590	12000	12400	12040	12400	12000	12500	14300	12900	12450	12100	12100	13200	11900	11300	13800	11300	14300	12281
TDS	25100	26300	22000	24100	25000	25700	22800	24000	27100	25200	23800	24200	26700	24600	24500	24300	22600	24400	23900	24000	25000	24000	22000	27100	24514
MW-5D																									
Chloride	12100	12000	9120	7810	9600	8400	5880	8000	6925	9040	9410	10500	8740	10600	8120	10960	10600	14370	11800	13300	12500	13200	5860	14370	10134
TDS	21000	23500	17400	15800	17700	16800	12500	15000	14000	18100	19000	20000	16900	20000	19000	19800	20400	19900	21700	22000	21000	21000	12500	23500	18841
(Note: MW-5D is not screened in the Bedrock Formation)																									
TDS: Total Dissolved Solids																									

**Table 3-3**  
**Summary of 1-Mile Radius Well Search**  
**Records of Wells Other Than Monitoring Wells**  
**Cytec Industries, Inc. - Carteret Impoundments**  
**Carteret, NJ**

<b>Owner Owner Address</b>	<b>Land Use</b>	<b>Location Relative to Site</b>	<b>Comments</b>
Amoco Oil Co. Roosevelt Ave. Carteret, NJ	Ind.	SW	Upgradient of Site 2 recovery wells installed 1990 Well depths 19' & 20'
Borough of Carteret Cooke Ave. Carteret, NJ	Park	S	Upgradient of Site Installed 1964. Well depth 95' Used for irrigation purposes Status uncertain
Citgo PO Box 467 Linden, NJ 07036	Ind.	SW	Upgradient of Site Installed 1981. Well depth 20' Recovery Well
C. Gerry P.O. Box 425 Rahway, NJ	Res.	SW	Upgradient of Site Installed 1957 Present status uncertain.
A. Kish 83 Clauss St. Carteret, NJ	Res.	SW	Upgradient of Site Installed 1954 Present status uncertain
International Brokerage Roosevelt Ave. Carteret, NJ	Ind.	SW	Upgradient of Site Well record states that well no longer functional
Gulf Stream Development Cor Wall Street Station, Box 712 NY, NY 10005	Ind.	SW	Upgradient of Site Well on Roosevelt Blvd. Installed 1967 Well depth 145'
Roselle Plastics Corp. 51 Lafayette St. Carteret, NJ	Ind.	SE	Upgradient of Site Installed 1959. Well depth 136' Present status uncertain
Unocal Corp. 1700 E. Golf Rd. Schaumburg, NJ	Ind.	SW	Upgradient of Site 7 recovery wells installed 1991 Well depths 7' - 38'
Vanguard 1000 Blair Rd. Carteret, NJ	Ind.	SW	Upgradient of Site Installed 1969. Well depth 300' Washing of trucks Present status uncertain

**TABLE 3-4**  
**REPRESENTATIVE FISH SPECIES FOR THE RAHWAY RIVER**  
 CYTEC INDUSTRIES INC. - CARTERET IMPOUNDMENTS  
 CARTERET, NEW JERSEY

COMMON NAME	SCIENTIFIC NAME
Alewife	Alosa Psuedoharegus
American Eel	Anguilla Rostrata
American Shad	Alosa Sapidissima
Atlantic Menhaden	Brevoortia Eyrannus
Atlantic Silverside	Meridia Menidia
Atlantic Tomcod	Microgaaus Tomcod
Bay Anchovy	Anchoa Mitchilli
Bluefish	Pomatomus Saltatrix
Grubby	?
Mummichog	Fundulus Heteroclitus
Northern Pipe Fish	Syngnathus Leptorhynchus
Striped Bass	Morone Saxatilis
Striped Seasobin	Prionotus Carolinus
Summer Flounder	Paralichthys Dentatus
Winter Flounder	Pseudoleuronectes Americanus
Weakfish	Cynoscion Regalis

(After USFWS, 1984)

**TABLE 3-5**  
**COMPARISON OF MAXIMUM CONCENTRATION OF CONTAMINANTS**  
**IN SHALLOW GROUND-WATER SAMPLES TO GWQC AND SWQS**  
**CYTEC INDUSTRIES, INC. - CARTERET IMPOUNDMENTS**  
**CARTERET, NJ**

MONITORING WELL N SAMPLE DATE	MAXIMUM CONCENTRATION  (mg/l)	PQL (4/5/93) (1)	GWQC CLASS II-A (4/5/93) (1)	SE3 SURFACE WATER QUALITY STANDARDS			RQLs (3)
				Human Health (12/20/93) (2)	Acute Toxicity (12/20/93) (2)	Chronic Toxicity (12/20/93) (2)	
VOC							
Acetone	0.0063	NA	0.7	NA	NA	NA	NA
Benzene	0.0045	0.001	0.0002	0.071	NA	NA	0.007
Carbon Disulfide	0.02	NA	NA	NA	NA	NA	NA
Chorobenzene	0.005	0.002	0.004	21	NA	NA	0.006
Toluene	0.12	0.005	1	200	NA	NA	0.006
Xylenes (total)	0.009	0.002	0.04	NA	NA	NA	NA
Water Quality Parameters							
Chloride	13700.0	2.0	250	NA	NA	NA	NA
Sulfate	690.0	5.0	250	NA	NA	NA	NA
TDS	26600.0	10.0	500	NA	NA	NA	NA
Cyanide							
Cyanide (free)	0.276	NA	NA	220	0.001	0.001	NA
Cyanide (total)	18.2	0.04	0.2	NA	NA	NA	0.04
Inorganics (Total)							
Aluminum	2.01 N	0.2	0.2	NA	NA	NA	NA
Aluminum (D)	0.566	0.2	0.2	NA	NA	NA	NA
Antimony	0.0146 B	0.02	0.002	4.3	NA	NA	0.020
Antimony (D)	0.0239 B N	0.02	0.002	4.3	NA	NA	0.020
Arsenic	0.0608 B N	0.008	0.00002	0.000136	NA	NA	0.008
Arsenic (D)	0.0508 B N	NA	NA	0.000136	NA	NA	0.008
Barium	1.06 NE	0.2	2.0	NA	NA	NA	0.020
Barium (D)	0.963 NE	0.2	2.0	NA	NA	NA	0.020
Beryllium	0.003 N	0.02	0.000008	R	R	R	0.020
Beryllium (D)	0.00057 B N	0.02	0.000008	NA	NA	NA	0.020
Cadmium	ND	0.002	0.004	NA	NA	NA	0.004
Cadmium (D)	ND	0.002	0.004	NA	NA	NA	0.004
Calcium	981.0	NA	NA	NA	NA	NA	NA
Calcium (D)	1210.0 E	NA	NA	NA	NA	NA	NA
Chromium	0.0336	0.01	0.1	3.23	NA	NA	0.010
Chromium (D)	0.0178	NA	NA	NA	NA	NA	0.010
Cobalt	0.0398	NA	NA	NA	NA	NA	NA
Cobalt (D)	0.0441	NA	NA	NA	NA	NA	NA
Copper	0.0089	1.0	1.0	R	R	R	0.010
Copper (D)	ND	1.0	1.0	NA	NA	NA	0.010
Iron	112.0 E	0.1	0.3	NA	NA	NA	NA
Iron (D)	43.0 E	0.1	0.3	NA	NA	NA	NA
Lead	0.0081	0.01	0.005	NA	NA	NA	0.010
Lead (D)	0.0096 *	NA	NA	NA	NA	NA	0.010
Magnesium	806.0	NA	NA	NA	NA	NA	NA
Magnesium (D)	1130.0 E	NA	NA	NA	NA	NA	NA
Manganese	3.69 E	0.006	0.050	0.1	NA	NA	NA
Manganese (D)	3.77 E	0.006	0.050	NA	NA	NA	NA
Mercury	0.00031 N	0.0005	0.002	0.000146	NA	NA	0.001
Mercury (D)	0.0002 N	NA	NA	NA	NA	NA	0.001
Nickel	0.0062 B	0.01	0.1	3.9	NA	NA	0.010
Nickel (D)	ND	0.01	0.1	NA	NA	NA	0.010
Potassium	230.0	NA	NA	NA	NA	NA	NA
Potassium (D)	224.0	NA	NA	NA	NA	NA	NA
Selenium	ND	0.01	0.050	NA	NA	NA	0.010
Selenium (D)	ND	NA	NA	NA	NA	NA	0.010
Silver	0.0144	0.002	NA	NA	NA	NA	0.002
Silver (D)	0.0045 B	0.002	NA	NA	NA	NA	0.002
Sodium	6230.0 E	0.4	50.0	NA	NA	NA	NA
Sodium (D)	6570.0	0.4	50.0	NA	NA	NA	NA
Thallium	0.0173 B N	0.01	0.0005	0.00622	NA	NA	0.010
Thallium (D)	0.0129 B N	0.01	0.0005	NA	NA	NA	0.010
Vanadium	0.0324	NA	NA	NA	NA	NA	NA
Vanadium (D)	0.0112 B	NA	NA	NA	NA	NA	NA
Zinc	0.0432	0.03	5.0	R	R	R	0.030
Zinc (D)	0.0233	0.03	5.0	NA	NA	NA	0.030

**Notes:**

D - dissolved

B - result is between the EQL (Estimated Quantitation Limit) and the IDL (Instrument Detection Limit)

E - serial dilution not within control limits

N - spiked sample recovery not within control limits

ND - not detected

\* - duplicate analysis not within control limits

NA - not available

R - reserved

(1) NJDEP Ground Water Quality Criteria (NJAC 7.9-6)

(2) SWQS (surface water quality standards) from NJAC 7.9B-1.14 RQLs (Recommended Quantitation Level) used as standard where RQL is greater than SWQS (H. Shah, NJDEP, personal communication, 09/20/94)

(3) RQL (Recommended Quantitation Levels) received from NJDEP July 11, 1994

**TABLE 3-6**  
**COMPARISON OF MAXIMUM CONCENTRATION OF CONTAMINANTS**  
**IN DEEP GROUND-WATER SAMPLES TO GWQC AND SWQS**  
**CYTEC INDUSTRIES, INC. - CARTERET IMPOUNDMENTS**  
**CARTERET, NJ**

MONITORING WELL NO SAMPLE DATE	MAXIMUM CONCENTRATION (mg/l)	PQL (4/5/93) (1)	GWQC CLASS II-A (4/5/93) (1)	SE3 SURFACE WATER QUALITY STANDARDS			RQLs (3)
				Human Health (12/20/93) (2)	Acute Toxicity (12/20/93) (2)	Chronic Toxicity (12/20/93) (2)	
VOC							
Acetone	0.008J	NA	0.7	NA	NA	NA	NA
Carbon Disulfide	0.043	NA	NA	NA	NA	NA	NA
Water Quality Parameters							
Chloride	13000.0	2.0	250	NA	NA	NA	NA
Sulfate	1060.0	5.0	250	NA	NA	NA	NA
TDS	27200.0	10.0	500	NA	NA	NA	NA
Cyanide							
Cyanide (free)	0.098	NA	NA	220	0.001	0.001	NA
Cyanide (total)	23.8	0.04	0.2	NA	NA	NA	0.04
Inorganics (Total)							
Aluminum	1.78 N	0.2	0.2	NA	NA	NA	NA
Aluminum (D)	0.194	0.2	0.2	NA	NA	NA	NA
Antimony	ND	0.02	0.002	4.3	NA	NA	0.020
Antimony (D)	0.0191 B N	0.02	0.002	4.3	NA	NA	0.020
Arsenic	0.0512 B N	0.008	0.00002	0.000136	NA	NA	0.008
Arsenic (D)	0.0738 B N	NA	NA	0.000136	NA	NA	0.008
Barium	0.299 NE	0.2	2.0	NA	NA	NA	0.020
Barium (D)	0.161 NE	0.2	2.0	NA	NA	NA	0.020
Beryllium	0.00064 N	0.02	0.000008	R	R	R	0.020
Beryllium (D)	0.00053 B N	0.02	0.000008	NA	NA	NA	0.020
Cadmium	0.0022 B	0.002	0.004	NA	NA	NA	0.004
Cadmium (D)	ND	0.002	0.004	NA	NA	NA	0.004
Calcium	2180.0	NA	NA	NA	NA	NA	NA
Calcium (D)	2460.0 E	NA	NA	NA	NA	NA	NA
Chromium	0.0013 B	0.01	0.1	3.23	NA	NA	0.010
Chromium (D)	0.0024 B	NA	NA	NA	NA	NA	0.010
Cobalt	0.0282	NA	NA	NA	NA	NA	NA
Cobalt (D)	0.0295	NA	NA	NA	NA	NA	NA
Copper	0.0186	1.0	1.0	R	R	R	0.010
Copper (D)	ND	1.0	1.0	NA	NA	NA	0.010
Iron	56.0 E	0.1	0.3	NA	NA	NA	NA
Iron (D)	13.1 E	0.1	0.3	NA	NA	NA	NA
Lead	0.0056	0.01	0.005	NA	NA	NA	0.010
Lead (D)	0.0012 B *	NA	NA	NA	NA	NA	0.010
Magnesium	844.0	NA	NA	NA	NA	NA	NA
Magnesium (D)	966.0 E	NA	NA	NA	NA	NA	NA
Manganese	2.62 E	0.006	0.050	0.1	NA	NA	NA
Manganese (D)	1.21 E	0.006	0.050	NA	NA	NA	NA
Mercury	0.00034 N	0.0005	0.002	0.000146	NA	NA	0.001
Mercury (D)	ND	NA	NA	NA	NA	NA	0.001
Nickel	0.0131 B	0.01	0.1	3.9	NA	NA	0.010
Nickel (D)	ND	0.01	0.1	NA	NA	NA	0.010
Potassium	197.0 NE	NA	NA	NA	NA	NA	NA
Potassium (D)	203.0 NE	NA	NA	NA	NA	NA	NA
Selenium	ND	0.01	0.050	NA	NA	NA	0.010
Selenium (D)	ND	NA	NA	NA	NA	NA	0.010
Silver	0.0054	0.002	NA	NA	NA	NA	0.002
Silver (D)	ND	0.002	NA	NA	NA	NA	0.002
Sodium	5490.0 E	0.4	50.0	NA	NA	NA	NA
Sodium (D)	6030.0	0.4	50.0	NA	NA	NA	NA
Thallium	0.0159 B N	0.01	0.0005	0.00622	NA	NA	0.010
Thallium (D)	0.0139 B N	0.01	0.0005	NA	NA	NA	0.010
Vanadium	0.00954 B N	NA	NA	NA	NA	NA	NA
Vanadium (D)	ND	NA	NA	NA	NA	NA	NA
Zinc	0.168	0.03	5.0	R	R	R	0.030
Zinc (D)	0.0483	0.03	5.0	NA	NA	NA	0.030

**Notes:**

D - dissolved

B - result is between the EQL (Estimated Quantitation Limit) and the IDL (Instrument Detection Limit)

E - serial dilution not within control limits

N - spiked sample recovery not within control limits

ND - not detected

\* - duplicate analysis not within control limits

NA - not available

R - reserved

(1) NJDEP Ground Water Quality Criteria (NJAC 7.9-6)

(2) SWQS (surface water quality standards) from NJAC 7.9B-1.14. RQLs (Recommended Quantitation Level) used as standard where RQL is greater than SWQS (H. Shah, NJDEP, personal communication, 09/20/94)

(3) RQL (Recommended Quantitation Levels) received from NJDEP July 11, 1994

**Table 3-7**  
**Evaluation of Ground-Water Analytical Data**  
**Cytec Industries - Carteret Impoundments**  
**Carteret, NJ**

Ground-Water Unit	Inorganics				Organics			
	> II-A Criteria	>SWQC			> II-A Criteria	>SWQC		
		human health	acute toxicity	chronic toxicity		human health	acute toxicity	chronic toxicity
Shallow	cyanide (t) aluminum (t) aluminum (d) arsenic (t) arsenic (d) iron (t) iron (d) manganese (t) manganese (d) silver (t) thallium (t) chloride sulfate cyanide (t)	arsenic (t) arsenic (d) manganese (t) thallium (t)	cyanide (free)	cyanide (free)	benzene chlorobenzene	none	none	none
Deep	aluminum (t) antimony (d) arsenic (t) iron (t) iron (d) manganese (t) manganese (d) sodium (t) sodium (d) thallium (t) thallium (d) chloride sulfate TDS cyanide (t)	arsenic (t) arsenic (d)	cyanide (free)	cyanide (free)	none	none	none	none

Notes:

(t)-total

(d) - dissolved

(2) RQLs (Recommended Quantitation Level) and PQLs (Practical Quantitation Limit) used as standard/criteria where RQL/PQL greater than SWQS/GWQC, respectively (H. Shah, NJDEP, personal communication, 09/20/94)

(3) RQL (Recommended Quantitation Levels) received from NJDEP July 11, 1994

None: no contaminants analyzed for were detected above criteria

**Table 3-8**  
**Summary Screening Criteria for Protection of Human Health and Aquatic Life - Surface Water**  
**Cytec Industries, Inc. - Carteret Impoundments**  
**Carteret, NJ**

Compound	Human Health WQC (mg/l)	Reference	Acute WQC (mg/l)	Acute LOEL (mg/l)	Test Species	Extrapolation Factor	Acute Benchmark (mg/l)	Reference	Chronic WQC (mg/l)	Chronic LOEL (mg/l)	Test Species	Extrapolation Factor	Chronic Benchmark (mg/l)	Reference
<b>VOC</b>														
Benzene	0.071	25 NJR	NA	5.1	-	10L, 10F	0.051	USEPA 1980	NA	0.7	-	10L, 10F	0.007	USEPA 1980
Chlorobenzene	21	USEPA 1991	NA	10.5	sheepshead minnow	10L	1.05	USEPA 1980a	NA	NA	sheepshead minnow	10L, 10A	0.105	USEPA 1980a
<b>Inorganics</b>														
Cyanide	0.22		0.001	-	-	-	0.001	25 NJR	0.001	-	-	-	0.001	25 NJR
<b>Trace Metals</b>														
Aluminum	NA	25 NJR, USEPA 1993	NA	-	-	-	NA	25 NJR, USEPA 1993	NA	-	-	-	NA	25 NJR, USEPA 1993
Arsenic	0.008	25 NJR	0.069	-	-	-	0.069	USEPA 1980b	0.036	-	-	-	0.036	USEPA 1980b
Iron	NA		NA	-	-	-	-	25 NJR, USEPA 1991	NA	-	-	-	-	25 NJR, USEPA 1991
Manganese	0.1	25 NJR	NA	-	-	-	-	25 NJR, USEPA 1991	NA	-	-	-	-	25 NJR, USEPA 1991
Silver	65	USEPA 1993	NA	1.4	sheepshead minnow	10L	0.14	USEPA 1980c	NA	-	sheepshead minnow	10L, 10A	0.014	USEPA 1980c
Thallium	0.00622	25 NJR	NA	2.13	-	10L, 10F	0.021	USEPA 1986	NA	-	-	10L, 10F, 10A	0.002	USEPA 1986

NA not available

WQC: water quality standard (N.J.A.C. 7:9, USEPA Quality Criteria for Water 1986)

LOEL: lowest observed effect level measured in tests with aquatic organisms

Extrapolation factors are used to adjust LOEL

10L: used to extrapolate LOEL to NOEL

10F: used to extrapolate between species

10A: used to extrapolate acute to chronic endpoints

USEPA 1980: Ambient Water Quality Criteria for Benzene. PB #1 -117293

USEPA 1980a: Ambient Water Quality Criteria for Chlorinated Benzenes. PB #1 -117392

USEPA 1980b: Ambient Water Quality Criteria for Arsenic. PB #5-227495

USEPA 1980c: Ambient Water Quality Criteria for Silver. PB #1 -117822

USEPA 1986: Quality Criteria for Water. EPA 480/5-86-001

USEPA 1991: Amendments to the Water Quality Standards Regulation to Establish the Numeric Criteria for Priority Toxic Pollutants to Bring All States into Compliance with Section 303 (1)(2)(B). Federal Register Vol. 56, No. 223

25 NJR: 25 New Jersey Register, pp. 5652-5655

Human Health WQC: consumption of organisms only

TABLE 3-9  
**SUMMARY OF PRELIMINARY III-B GWQC**  
 CYTEC INDUSTRIES INC. - CARTERET IMPOUNDMENTS  
 CARTERET, NEW JERSEY  
 REPORT

Compound	Acceptable Chronic Surface Water Concentration (mg/l)	Preliminary III-B GWQC (mg/l)					
		Rahway River Tidal Exchange (R)					
		R = 0		R = 0.1		R = 0.67	
		Qe = 0.01	Qe = 0.02	Qe = 0.01	Qe = 0.02	Qe = 0.01	Qe = 0.02
<b>VOCs</b>							
Benzene	0.007	34	17	90	45	164	83
Chlorobenzene	0.105	504	252	1344	672	2457	1239
<b>Inorganics</b>							
Aluminum	NA	NA	NA	NA	NA	NA	NA
Arsenic	0.008	39	19	102	51	187	94
Cyanide (free)	0.001	5	2.5	13	6.5	23	12
Iron	1	4800	2400	12800	6400	23400	11800
Manganese	0.1	480	240	1280	640	2340	1180
Silver	0.014	67	34	179	90	328	165
Thallium	0.002	10	5	26	13	47	24

NA: not available



**Table 3-10**  
**Comparison of Maximum Contaminant of Concern Concentrations and Preliminary III-B GWQC**  
**Cytec Industries Inc. - Carteret Impoundments**  
**Carteret, New Jersey**

Unit	Compound	Maximum Detected Concentration (mg/l)	Rahway River Tidal Exchange (R)					
			R = 0		R = 0.1		R = 0.67	
			Qe = 0.01	Qe = 0.02	Qe = 0.01	Qe = 0.02	Qe = 0.01	Qe = 0.02
Shallow	VOC							
	Benzene	0.0045	34	17	90	45	164	83
	Chlorobenzene	0.005	504	252	1344	672	2457	1239
	Inorganics							
	Aluminum	2.01 N	NA	NA	NA	NA	NA	NA
	Aluminum (dissolved)	0.566	NA	NA	NA	NA	NA	NA
	Arsenic	0.0608 B N	39	19	102	51	187	94
	Arsenic (dissolved)	0.0508 B N	39	19	102	51	187	94
	Cyanide (free)	0.276	5	2.5	13	6.5	23	12
	Iron	112.0 E	4800	2400	12800	6400	23400	11800
	Iron (dissolved)	43.0 E	4800	2400	12800	6400	23400	11800
	Manganese	3.69 E	480	240	1280	640	2340	1180
	Manganese (dissolved)	3.77 E	480	240	1280	640	2340	1180
	Silver	0.0144	67	34	179	90	328	165
	Silver (dissolved)	0.0045 B	67	34	179	90	328	165
	Thallium	0.0173 B N	10	5	26	13	47	24
	Thallium (dissolved)	0.0129 B N	10	5	26	13	47	24

Notes:

B - result is between the EQL (Estimated Quantitation Limit) and the IDL (Instrument Detection Limit)

E - serial dilution not within control limits

N - spiked sample recovery not within control limits

**TABLE 4-1**  
**SLUG TEST DATA REDUCTION**  
**Cytec Industries: Carteret Impoundments**  
**Carteret, New Jersey**

AQTESOLV ANALYSIS OF A CONFINED AQUIFER BY THE  
COOPER BREDEHOEFT AND PAPADOPULOS METHOD

WELL	CRT-3D RISING	CRT-4D RISING	CRT-6S RISING	CRT-6D RISING	CRT-7S RISING	CRT-7D RISING
Unit Screened	Weathered Bedrock Confining Unit	Weathered Bedrock Confining Unit	Basal Clayey Gravel Unit	Fractured Bedrock	Basal Clayey Gravel Unit	Fractured Bedrock
<b>INPUT DATA</b>						
Initial Drawdown (ft.)	1.91	1.90	3.20	1.85	1.85	2.10
Casing Radius (ft.)	0.17	0.17	0.08	0.17	0.08	0.17
Well Radius (ft.)	0.33	0.33	0.25	0.33	0.25	0.33
b = Saturated Thickness (ft.)	17.50	12.50	6.00	13.00	7.00	25.00
Screen Length (ft.)	17.50	12.50	6.00	13.00	7.00	25.00
Height of Water Column (ft.)	44.21	44.70	22.75	58.28	25.72	90.38
<b>AQTESOLVE OUTPUT</b>						
T = Transmissivity (ft <sup>2</sup> /min)	COULD NOT REASONABLY	COULD NOT REASONABLY	1.15E-02	1.92E-02	1.43E-04	1.41E-01
S = Storativity	APPROXIMATE TYPE-	APPROXIMATE TYPE-	5.41E-04	1.00E-08	3.36E-02	1.78E-06
Residual Sum of Squares	CURVE MATCH	CURVE MATCH	0.5	0.4	2.8	0.5
<b>CONVERSIONS</b>						
K = Hydraulic Conductivity (ft/min)			1.91E-03	1.48E-03	2.04E-05	5.62E-03
K = Hydraulic Conductivity (cm/s)			9.71E-04	7.51E-04	1.04E-05	2.86E-03

AQTESOLV ANALYSIS OF AN UNCONFINED  
AQUIFER BY THE BOUWER AND RICE METHOD

WELL	CRT-3S RISING	CRT-4S RISING	CRT-3D RISING	CRT-4D RISING	HYDRAULIC UNIT	MEAN HORIZONTAL K (ft/min)
Unit Screened	Tidal Marsh Deposit	Tidal Marsh Deposit	Weathered Bedrock Confining Unit	Weathered Bedrock Confining Unit		
<b>INPUT DATA</b>						
Initial Drawdown (ft.)	2.23	2.12	1.91	1.90	TIDAL MARSH DEPOSIT	2.2E-05
Casing Radius (ft.)	0.17	0.17	0.17	0.17	BASAL CLAYEY GRAVEL UNIT	9.7E-04
Well Radius (ft.)	0.33	0.33	0.33	0.33	WEATHERED BEDROCK	3.9E-06
b = Saturated Thickness (ft.)	21.97	25.02	17.50	12.50	BEDROCK (FIRST WATER- BEARING FRACTURE SET)	3.6E-03
Screen Length (ft.)	21.00	15.00	17.50	12.50		
Height of Water Column (ft.)	22.73	17.02	44.21	44.70		
<b>AQTESOLV OUTPUT</b>						
K = Hydraulic Conductivity (ft/min)	3.09E-06	4.05E-05	9.84E-07	6.90E-06		
Residual Sum of Squares	2.88E-01					
<b>CONVERSIONS</b>						
K = Hydraulic Conductivity (cm/s)	1.57E-06	2.06E-05	5.00E-07	3.51E-06		

TABLE 4-2

# GROUND-WATER DISCHARGE CALCULATIONS

## Cyttec Industries: Carteret Impoundments

### Carteret, New Jersey

HYDRAULIC GRADIENT CALCULATION	CRT-3	CRT-4	CRT-6	CRT-7	AVERAGE
MEAN Overburden Ground-Water Elevation	3.16	4.33	2.03	2.83	3.0875
MEAN Rahway River Elevation	1.14	1.14	1.14	1.14	1.14
Approximate Distance to Main Channel From Well Cluster	300	260	475	400	358.75
Hydraulic Gradient - i	0.0067	0.0123	0.0019	0.0042	0.0063
MEAN HYDRAULIC CONDUCTIVITY - K	ft/day				
Tidal Marsh Deposit					3.14E-02
Basal Clayey Gravel Unit					1.39E+00
EFFECTIVE POROSITY - n					
Tidal Marsh Deposit					50.00%
Basal Clayey Gravel Unit					25.00%
SEEPAGE VELOCITY - (Ki)/n	ft/day				
Tidal Marsh Deposit					3.94E-04
Basal Clayey Gravel Unit					3.49E-02
DISCHARGE PERIMETER DISTANCE	feet				
					3370
UNIT THICKNESS CALCULATIONS					
Top of Weathered Bedrock (Elev.)	-22.47	-21.89	-23.05	-23.99	-22.85
Saturated thickness (Total)	25.63	26.22	25.08	26.82	25.94
Tidal Marsh Deposit	20.28	21.52	19.08	19.82	20.17
Basal Clayey Gravel Unit	5.35	4.70	6.00	7.00	5.76
MEAN DISCHARGE AREA	ft <sup>2</sup>				
Tidal Marsh Deposit					68,009
Basal Clayey Gravel Unit					19,410
GROUND-WATER DISCHARGE - Q=VA	ft <sup>3</sup> /day	gpd			
Tidal Marsh Deposit	27	200			
Basal Clayey Gravel Unit	679	5,075			
TOTAL	706	5,275			

**TABLE 4-3**  
**SUMMARY OF III-B GWQC**  
CYTEC INDUSTRIES INC. - CARTERET IMPOUNDMENTS  
CARTERET, NEW JERSEY  
REPORT

Compound	Acceptable Chronic Surface Water Concentration (mg/l)	III-B GWQC (mg/l)		
		Rahway River Tidal Exchange (R)		
		R = 0 Qe = 0.00816	R = 0.1 Qe = 0.00816	R = 0.67 Qe = 0.00816
<b>VOCs</b>				
Benzene	0.007	41	110	225
Chlorobenzene	0.105	616	1652	3378
<b>Inorganics</b>				
Aluminum	NA	NA	NA	NA
Arsenic	0.008	47	126	257
Cyanide (free)	0.001	6	16	32
Iron	1	5871	15736	32170
Manganese	0.1	587	1574	3217
Silver	0.014	82	220	450
Thallium	0.002	12	31	64

NA: not available

**Table 4-4**  
**Comparison of Maximum Contaminant of Concern Concentrations and III-B GWQC**  
**Cytex Industries Inc. - Carteret Impoundments**  
**Carteret, New Jersey**

Unit	Compound	Maximum Detected Concentration (mg/l)	Rahway River Tidal Exchange (R)		
			R = 0 Qe = 0.01	R = 0.1 Qe = 0.01	R = 0.67 Qe = 0.01
Shallow	<b>VOC</b>				
	Benzene	0.0045	41	110	225
	Chlorobenzene	0.005	616	1652	3378
	<b>Inorganics</b>				
	Aluminum	2.01 N	NA	NA	NA
	Aluminum (dissolved)	0.566	NA	NA	NA
	Arsenic	0.0608 B N	47	126	257
	Arsenic (dissolved)	0.0508 B N	47	126	257
	Cyanide (free)	0.276	6	16	32
	Iron	112.0 E	5871	15736	32170
	Iron (dissolved)	43.0 E	5871	15736	32170
	Manganese	3.69 E	587	1574	3217
	Manganese (dissolved)	3.77 E	587	1574	3217
	Silver	0.0144	82	220	450
	Silver (dissolved)	0.0045 B	82	220	450
	Thallium	0.0173 B N	12	31	64
	Thallium (dissolved)	0.0129 B N	12	31	64

Notes:

B - result is between the EQL (Estimated Quantitation Limit) and the IDL (Instrument Detection Limit)

E - serial dilution not within control limits

N - spiked sample recovery not within control limits

**TABLE 5-1**  
**FAST TRACK PROJECT SCHEDULE**  
**CYTEC INDUSTRIES - CARTERET IMPOUNDMENTS**  
**CARTERET, NEW JERSEY**

[illegible]

Table 5-2 (EXAMPLE)  
 Summary of Analytical Results  
 Semi-Annual Surface Water Monitoring  
 Cytec Industries Inc. - Carteret Impoundments  
 Carteret, New Jersey

Location Sampling Date Analysis Date	SW-1	SW-2	SW-3	FB	SW-BD	SE3 SURFACE WATER QUALITY STANDARDS					Exceedance of Standard
						Human Health	Acute Toxicity	Chronic Toxicity	RQLs	MDLs	
Sample Parameter / Frequency											
Semi-Annual											
Cyanide											
Cyanide (free)											
Inorganics											
Aluminum											
Aluminum (dissolved)											
Arsenic											
Arsenic (dissolved)											
Cyanide (free)											
Iron											
Iron (dissolved)											
Manganese											
Manganese (dissolved)											
Silver											
Silver (dissolved)											
Thallium											
Thallium (dissolved)											

*Antimony*

Add VOCs

**Table 5-3 (EXAMPLE)**  
**Summary of Analytical Results**  
**Semi-Annual Ground-Water Monitoring**  
**Cytec Industries Inc. - Carteret Impoundments**  
**Carteret, New Jersey**

[illegible]





# APPENDICES

**APPENDIX A**  
**Discharge Calculations**

## APPENDIX A - DISCHARGE CALCULATIONS

**Objective:** Calculate daily discharge (Q) [Q, in gallons per day (GPD)] moving through the saturated thickness plane above the red clay along line A-E. See Figures 2-3 and 2-4 for well location and saturated thickness plane locations.

### **Definitions:**

K	=	Hydraulic conductivity (cm/sec or ft/day)
dh/dl	=	Hydraulic gradient (dimensionless)
A <sub>A-B</sub>	=	Total area of saturated thickness plane between points A and B (see Figures 2-3 and 2-4) (ft <sup>2</sup> )
A <sub>C-D</sub>	=	Total area of saturated thickness plane between points C and D (see Figures 2-3 and 2-4)
V <sub>gw</sub>	=	Ground-water flow velocity (ft/day)
Q <sub>A-B</sub>	=	Ground-water discharge estimate for saturated thickness along A-B
Q <sub>C-D</sub>	=	Ground-water discharge through saturated thickness plane between points C and D (see Figures 2-3 and 2-4) used for Q <sub>max</sub> calculation
Q <sub>R</sub>	=	Total ground-water discharge through saturated thickness plane along lines A-B-C and D-E
Q <sub>min</sub>	=	Minimum ground-water discharge estimate for saturated thickness plane A-B-C-D-E (GPD)
Q <sub>max</sub>	=	Maximum ground-water discharge estimate to Rahway River for line A-B-C-D-E (GPD)

### **Facts Summary:**

Distance CRT-5 → CRT-6	=	870.66 ft
Distance CRT-2 → CRT-7	=	753.27 ft
Length of line A-B	=	925.72 ft
Length of line C-D	=	2,166.00 ft
Mean K	=	3.87 x 10 <sup>-4</sup> cm/sec or 1.10 ft/day
Mean dh/dl	=	1.46 <sup>-3</sup>
A <sub>A-B</sub>	=	18,158.00 ft <sup>2</sup>
A <sub>C-D</sub>	=	54,409.92 ft <sup>2</sup>

### **Calculation Results:**

Mean V <sub>gw</sub>	=	7.97 <sup>-3</sup> ft/day
Mean Q <sub>A-B</sub>	=	1,077 GPD
Mean Q <sub>A-B</sub> /linear foot	=	$\frac{1.16 \text{ gal/day}}{\text{ft}}$
Q <sub>min</sub>	=	6,401 GPD ≈ 6,400 GPD
Q <sub>max</sub>	=	10,429 GPD ≈ 10,430 GPD

SUMMARY OF K VALUES FROM DISKO, 1982  
CYTEC INDUSTRIES  
CARTERET IMPOUNDMENTS

All eight sludge and natural material above red clay.

Boring	Unit	Value (cm/sec)	Depth Below Ground Surface (ft)
B-1	Sludge	$5.3 \cdot 5$	14
		$7.4 \cdot 6$	16
	Meadow Mat	$1.5 \cdot 5$	18
		$8.4 \cdot 6$	20
B-3	Sludge	$7.5 \cdot 6$	20
	Meadow Mat	$1.2 \cdot 5$	22
		$5.7 \cdot 3$	24
B-4	Sludge	$7.4 \cdot 6$	8
	Meadow Mat	$1.3 \cdot 6$	12
	Gray Sandy Silt	$3.6 \cdot 5$	14
		$3.8 \cdot 4$	18
B-5	Sludge	$1.29 \cdot 5$	18
		$2.8 \cdot 6$	26
B-6A	Sludge	$3.7 \cdot 6$	14
		$6.7 \cdot 6$	18
B-7	Meadow Mat	$3.2 \cdot 4$	18
B-8	Meadow Mat	$4.5 \cdot 6$	22

Mean K =  $3.87 \cdot 4$  cm/sec

**Mean gradient CRT-5 → CRT-6: Distance = 870.66 ft**

- High tide gradient:

$$\text{CRT-5} \rightarrow \text{CRT-6} = \frac{3.15 - 1.96}{870.66} = 1.37^{-3} \text{ ft/ft}$$

- Low tide gradient:

$$\frac{3.02 - 1.69}{870.66} = 1.53^{-3} \text{ ft/ft}$$

- Mean gradient:  $1.45 \times 10^{-3} \text{ ft/ft}$

**Mean gradient CRT-2 → CRT-7: Distance = 753.27**

- High tide gradient:

$$\frac{3.73 - 2.65}{753.27} = 1.43^{-3} \text{ ft/ft}$$

- Low tide gradient:

$$\frac{3.62 - 2.50}{753.27} = 1.49^{-3} \text{ ft/ft}$$

- Mean gradient:  $1.46^{-3} \text{ ft/ft}$

<b>Mean Gradient = <math>1.46^{-3} \text{ ft/ft}</math></b>
---

Mean  $V_{gw}$ :

$$\begin{aligned} V_{gw} &= K \frac{(dh/dl)}{n} \quad K = 3.87^{-4}, \quad \frac{dh}{dl} = 1.46^{-3}, \quad n = 0.20 \\ &= \frac{(3.87^{-4} \text{ cm/sec}) (1.46^{-3})}{0.20} \\ &= 2.83^{-6} \text{ cm/sec} \end{aligned}$$

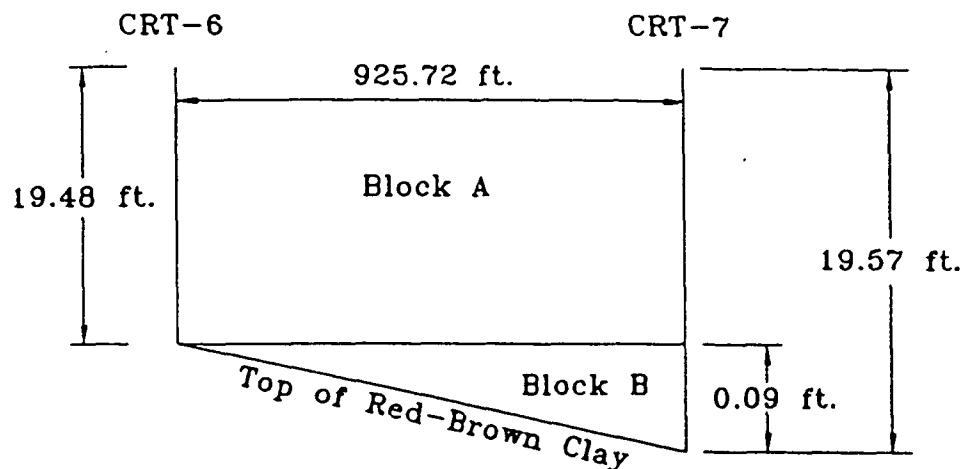
Conversion Factors:

0.0328 ft/cm; 86,400 sec/day

$$\frac{2.83^{-6} \text{ cm}}{1 \text{ sec}} \times \frac{0.0328 \text{ ft}}{1 \text{ cm}} \times \frac{86,400 \text{ sec}}{1 \text{ day}} = 7.97^{-3} \text{ ft/day}$$

$$V_{gw} = 7.97^{-3} \text{ ft/day}$$

Area of saturated thickness plane A-B  
 (See Figure 2-3 and 2-4 for locations, Table 2-1  
 for Stratigraphic Data and Table 2-2 for Water Level  
 Elevation Data.



#### Saturated Thickness Calculations:

##### CRT-6

$$\begin{aligned} \text{Mean Ground-water Elevation at CRT-6} &= \frac{1.96 \text{ ft. MSL} + 1.6 \text{ ft. MSL}}{2} \\ &= 1.83 \text{ ft. MSL} \\ \text{Top of Red-Brown Clay Elevation at CRT-6} &= -17.65 \text{ ft. MSL} \\ \text{Saturated thickness at CRT-6} &= 19.48 \text{ ft.} \end{aligned}$$

##### CRT-7

$$\begin{aligned} \text{Mean Ground-water Elevation at CRT-7} &= \frac{2.65 \text{ ft. MSL} + 2.50 \text{ ft. MSL}}{2} \\ &= 2.58 \text{ ft. MSL} \\ \text{Top of Red-Brown Clay Elevation at CRT-7} &= -16.99 \text{ ft. MSL} \\ \text{Saturated thickness at CRT-7} &= 19.57 \text{ ft.} \end{aligned}$$

#### $A_{AB}$ Calculations

$$\begin{aligned} \text{Area of Block A} &= 19.57 \text{ ft.} \times 925.72 \text{ ft.} = 18,116.34 \text{ ft.}^2 \\ \text{Area of Block B} &= \frac{0.09 \text{ ft.} \times 925.72 \text{ ft.}}{2} = 41.66 \text{ ft.}^2 \end{aligned}$$

$$A_{AB} = 18,116.34 \text{ ft.}^2 + 41.66 \text{ ft.}^2 = 18,158.00 \text{ ft.}^2$$

**Mean Q:**

$$\begin{aligned} Q &= V_{gw} \times A_{A-B} \text{ where } A_{A-B} = 18,158.00 \text{ ft}^2 \text{ and } V_{gw} = 7.97 \text{ ft/day} \\ &= 7.97 \frac{\text{ft}}{\text{day}} \times 18,070.06 \text{ ft}^2 \\ &= 144.00 \text{ ft}^3/\text{day} \end{aligned}$$

**Conversion Factor:**

$$\frac{7.48 \text{ gal}}{1 \text{ ft}^3}$$

$$144.00 \text{ ft}^3/\text{day} \times 7.48 \text{ gal}/1 \text{ ft}^3 = 1,077.12 \text{ GPD}$$

**Gal/Day/Lin. Ft. Estimation:**

$$\frac{1,077.12 \text{ gal/day}}{925.72 \text{ ft}} = \frac{1.16 \text{ GPD}}{\text{ft}}$$

**$Q_{min}$  Calculation:**

Total length of shoreline along line A-B-C-D-E = 5,518 ft

$$Q_{min} = 5,518 \text{ ft} \times \frac{1.16 \text{ GPD}}{\text{ft}}$$

$$= 6,400.88 \text{ GPD}$$

$$\approx 6,401 \text{ GPD}$$



**Q<sub>max</sub> Calculation:**

**Objective:** Calculate daily Q along line A-B-C-D-E for water moving through the saturated plane above the red clay using the assumption that hydraulic gradients in the area between CRT-3 and CRT-4 (line C-D, see Figures 2-3 and 2-4) are twice that of the remainder of the site.

**Calculation for Shoreline Segment CRT-3 → CRT-4:**

Line segment length = 2,166 ft

Line runs along shoreline from point adjacent to CRT-3 to point adjacent to CRT-2 (see Figures 2-3 and 2-4)

**Facts:**

Mean K =  $3.87^{-4}$  cm/sec = 1.10 ft/day

Mean gradient =  $1.46^{-3}$  x 2 =  $2.92^{-3}$

A<sub>C-D</sub> = 54,409 ft<sup>2</sup>

# Flow Velocity Calculations:

$$V_{gw} = \frac{K \left( \frac{dh}{dl} \right)}{n}$$

$$K = 3.87 \cdot 10^{-4} \text{ cm/sec or } 1.10$$

$$\frac{dh}{dl} = 2.92 \cdot 10^{-3}$$

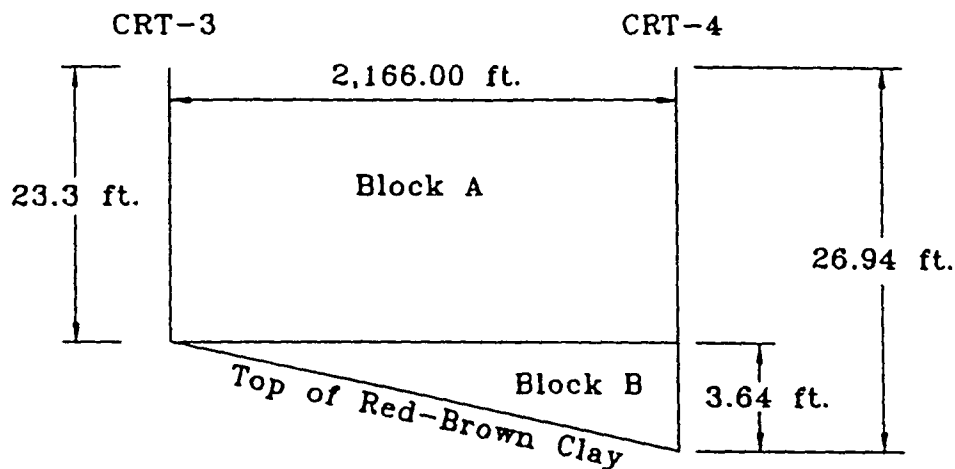
$$n = 0.20$$

$$V_{gw} = 5.65 \cdot 10^{-6} \text{ cm/sec}$$

or

$$V_{gw} = \frac{(1.10 \text{ ft/day}) (2.92 \cdot 10^{-3})}{0.20} = 1.61 \cdot 10^{-2} \text{ ft/day}$$

Area of saturated thickness plane C-D  
 (See Figure 2-3 and 2-4 for locations, Table 2-1  
 for Stratigraphic Data and Table 2-2 for Water Level  
 Elevation Data.



Saturated Thickness Calculations:

#### CRT-3

$$\begin{aligned} \text{Mean Ground-water Elevation at CRT-3} &= \frac{2.26 \text{ ft. MSL} + 3.74 \text{ ft. MSL}}{2} \\ &= 3.00 \text{ ft. MSL} \\ \text{Top of Red-Brown Clay Elevation at CRT-3} &= -20.30 \text{ ft. MSL} \\ \text{Saturated thickness at CRT-3} &= 23.30 \text{ ft.} \end{aligned}$$

#### CRT-4

$$\begin{aligned} \text{Mean Ground-water Elevation at CRT-4} &= \frac{4.00 \text{ ft. MSL} + 3.27 \text{ ft. MSL}}{2} \\ &= 3.64 \text{ ft. MSL} \\ \text{Top of Red-Brown Clay Elevation at CRT-4} &= -23.3 \text{ ft. MSL} \\ \text{Saturated thickness at CRT-4} &= 26.94 \text{ ft.} \end{aligned}$$

#### CD Calculations

$$\begin{aligned} \text{Area of Block A} &= 23.30 \text{ ft.} \times 2,166.00 \text{ ft.} = 50,467.80 \text{ ft.}^2 \\ \text{Area of Block B} &= \frac{3.64 \text{ ft.} \times 2,166.00 \text{ ft.}}{2} = 3,942.12 \text{ ft.}^2 \end{aligned}$$

$$A_{CD} = 50,467.80 \text{ ft.}^2 + 3,942.12 \text{ ft.}^2 = 54,409.92 \text{ ft.}^2$$

**Q<sub>C-D</sub> Calculation:**

$$\begin{aligned} Q_{C-D} &= V_{gw} \cdot A_{C-D} \\ &= 1.16^{-2} \text{ ft/day} \times 54,409.92 \text{ ft}^2 \\ &= 875.98 \text{ ft}^3/\text{day} \end{aligned}$$

**Conversion Factor:**

$$7.48 \text{ gal/ft}^3$$

$$875.98 \text{ ft}^3/\text{day} \times \frac{7.48 \text{ gal}}{\text{ft}^3} = 6,552 \text{ GPD}$$

$$Q/\text{linear feet} = \frac{6,552 \text{ GPD}}{2,166 \text{ ft}} = \frac{3.02 \text{ gal/day}}{\text{ft}}$$

**Q<sub>max</sub> Calculations:**

$$\text{Total shoreline length} = 5,518 \text{ ft}$$

$$\text{Length of line C-D (L}_{CD}) = 2,166 \text{ ft}$$

$$\text{Remaining shoreline length (L}_R) = 5,518 \text{ ft} - 2,166 \text{ ft} = 3,352 \text{ ft}$$

$$Q_1 = \text{Ground-water discharge value applied to L}_R = \frac{1.16 \text{ GPD}}{\text{ft}}$$

$$Q_2 = \text{Ground-water discharge value applied to L}_{CD} = \frac{3.02 \text{ GPD}}{\text{ft}}$$

$$\begin{aligned} Q_{CD} &= Q_2 \times L_{CD} \\ &= \frac{3.02 \text{ GPD}}{\text{ft}} \times 2,166 \text{ ft} \end{aligned}$$

$$= 6,541 \text{ GPD}$$

$$\begin{aligned} Q_R &= Q_1 \times L_R \\ &= \frac{1.16 \text{ GPD}}{\text{ft}} \times 3,352 \text{ ft} \end{aligned}$$

$$= 3,888 \text{ GPD}$$

$$\begin{aligned} Q_{max} &= 3,888 \text{ GPD} + 6,541 \text{ GPD} \\ &= 10,429 \text{ GPD} \end{aligned}$$

---

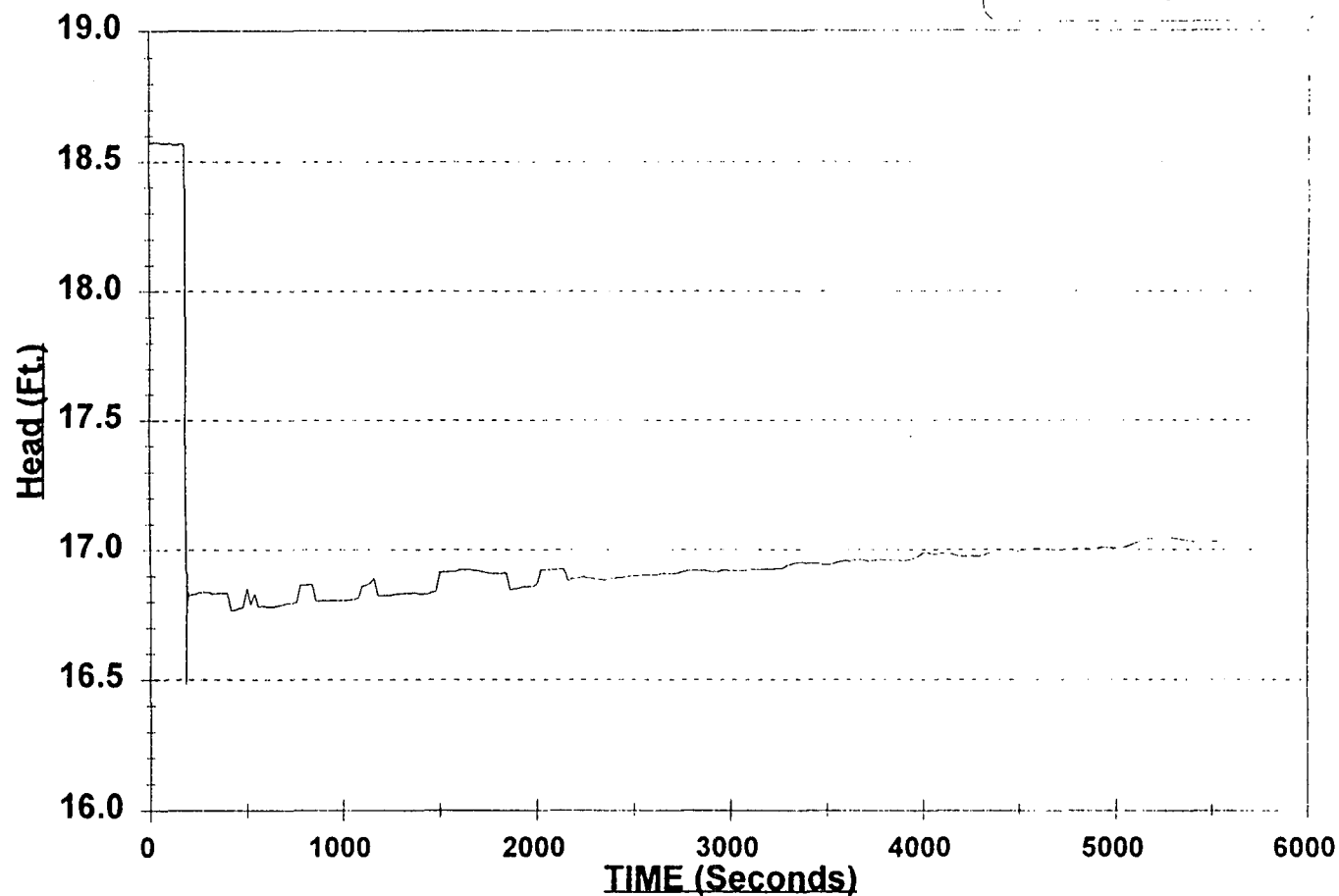
$$\text{Total } Q_{max} = 10,429 \text{ GPD}$$

$$\text{Total } Q_{min} = 1.16 \text{ GPD} \times 5,518 \text{ ft} = 6,401 \text{ GPD}$$

**APPENDIX B**  
**Slug Test Hydrographs**

## SLUG TEST HYDROGRAPH

CRT-3S RISING



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CARTERET IMPOUNDMENTS  
CARTERET, NEW JERSEY  
REMEDIAL ACTION PLAN ADDENDUM

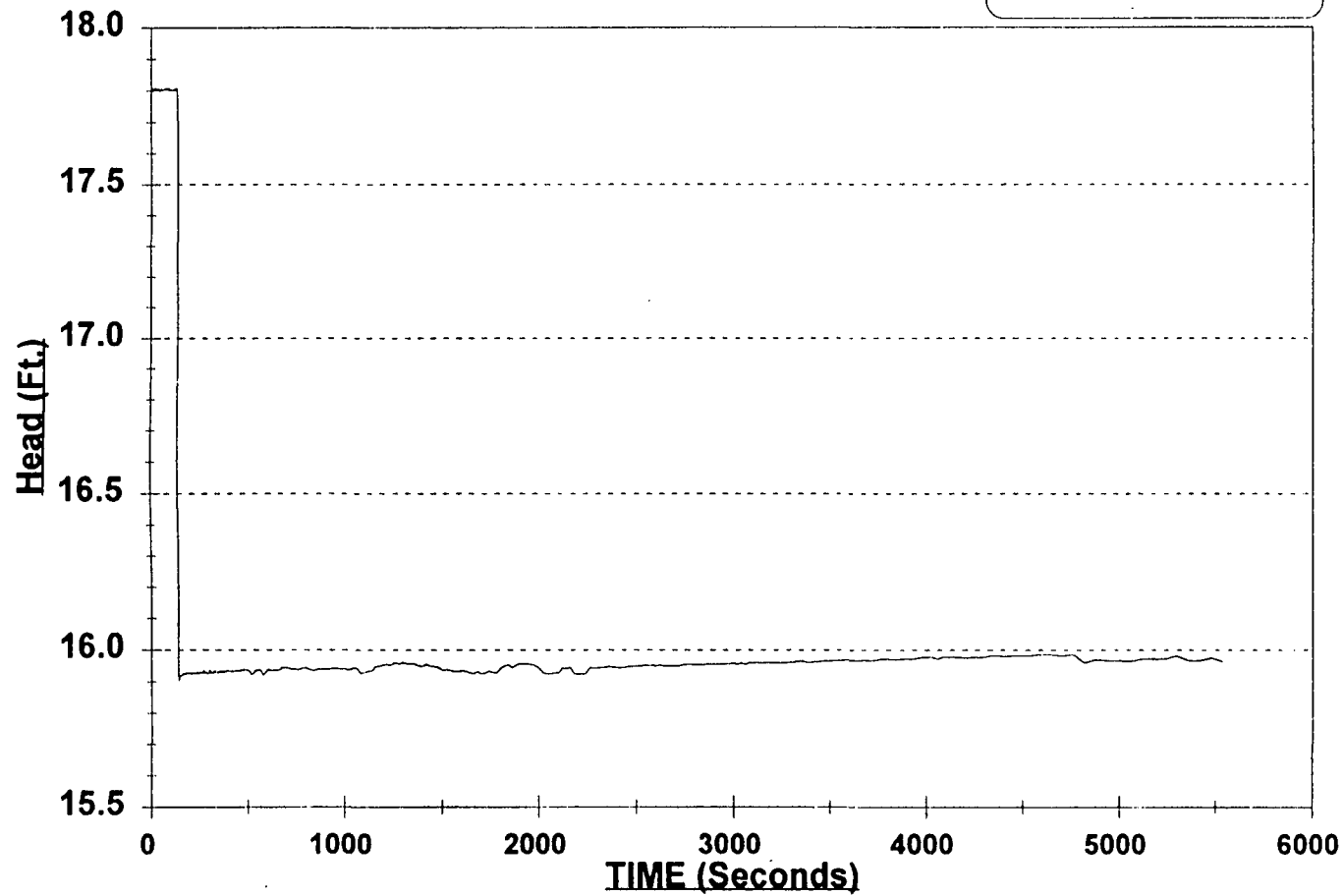
**APPENDIX B**

FIGURE

**1**

## SLUG TEST HYDROGRAPH

— CRT-3D RISING



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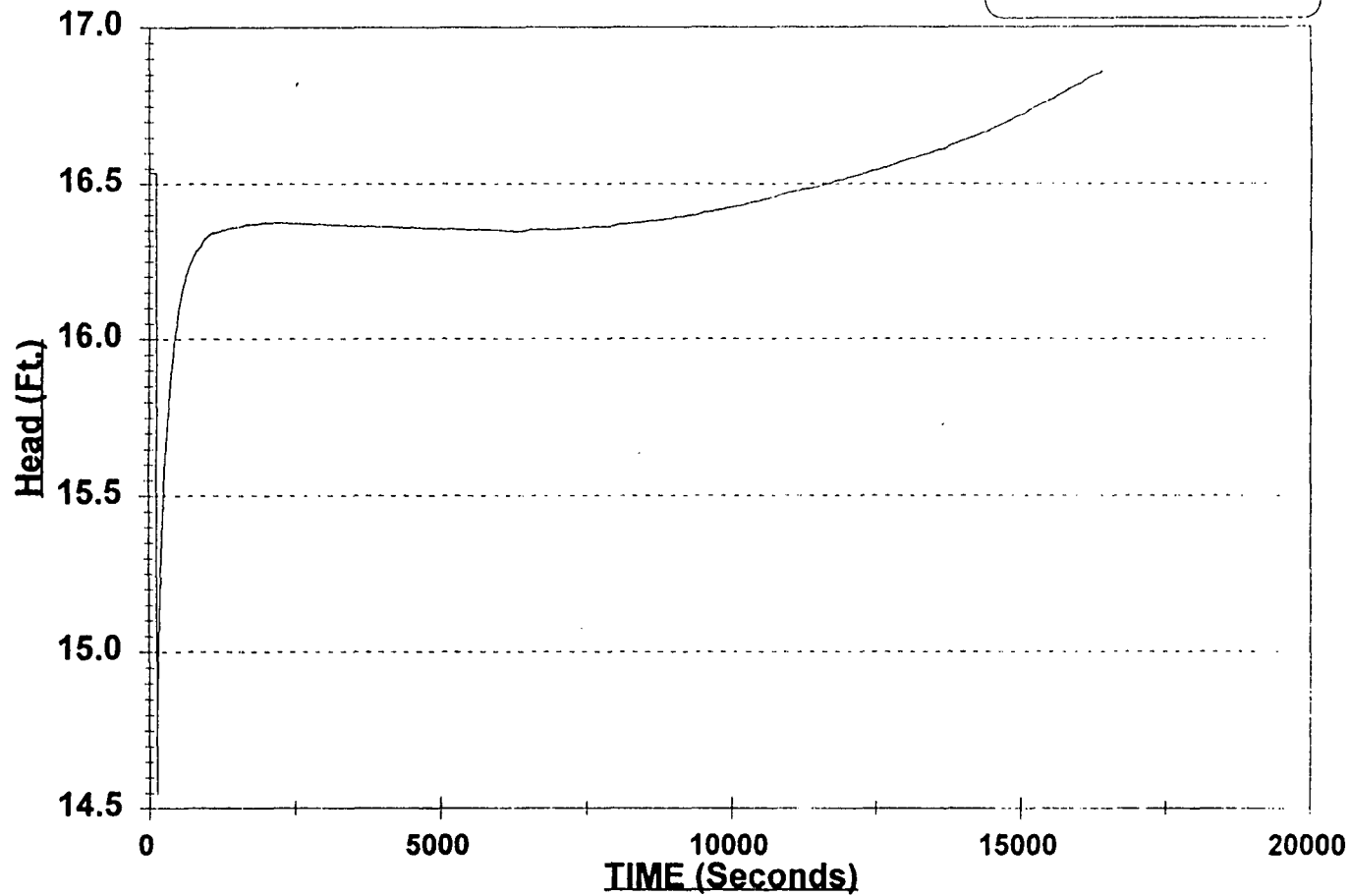
**APPENDIX B**

FIGURE

**2**

## SLUG TEST HYDROGRAPH

— CRT-4S RISING



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**APPENDIX B**

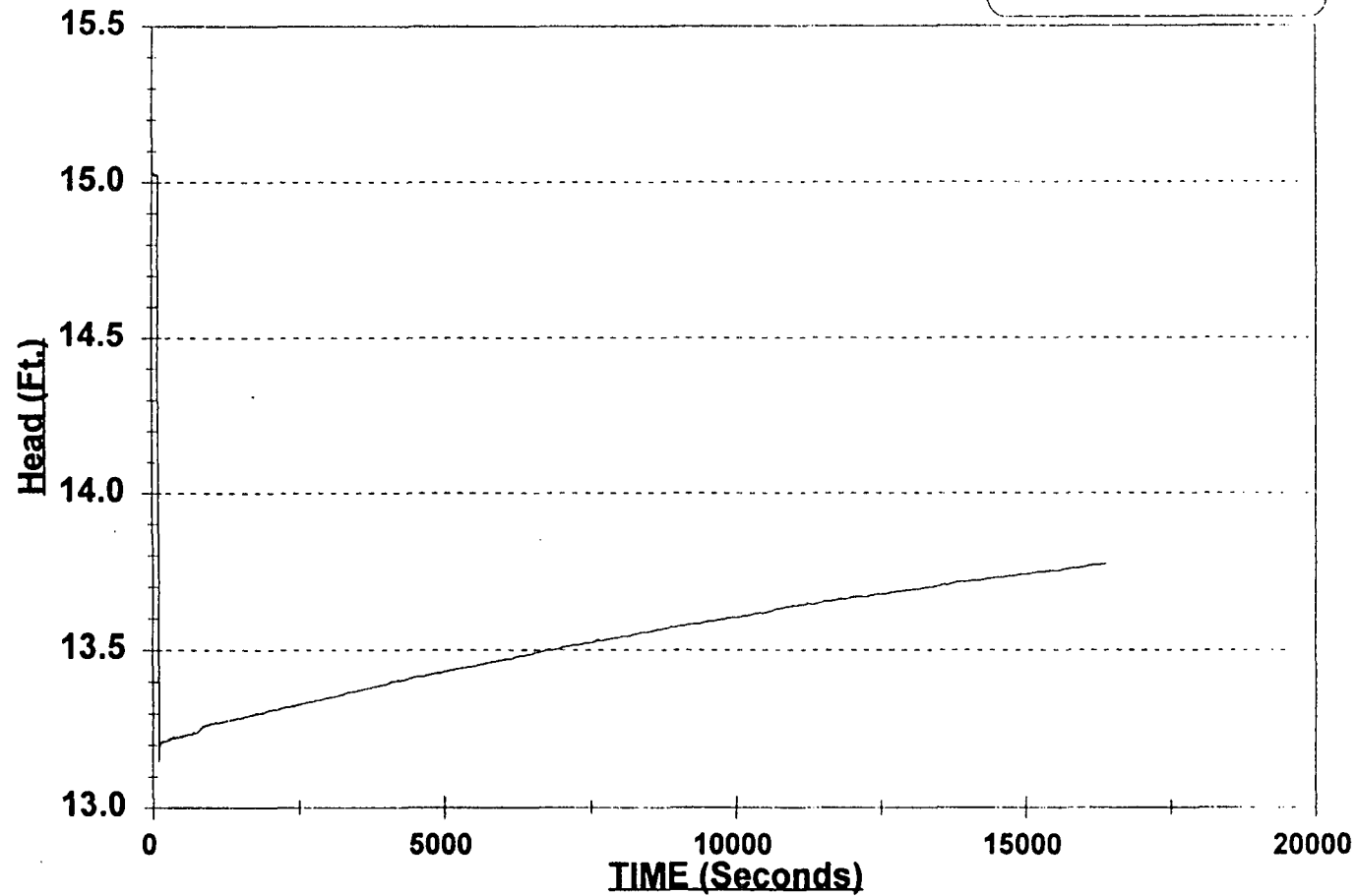
FIGURE

**3**



## SLUG TEST HYDROGRAPH

— CRT-4D RISING



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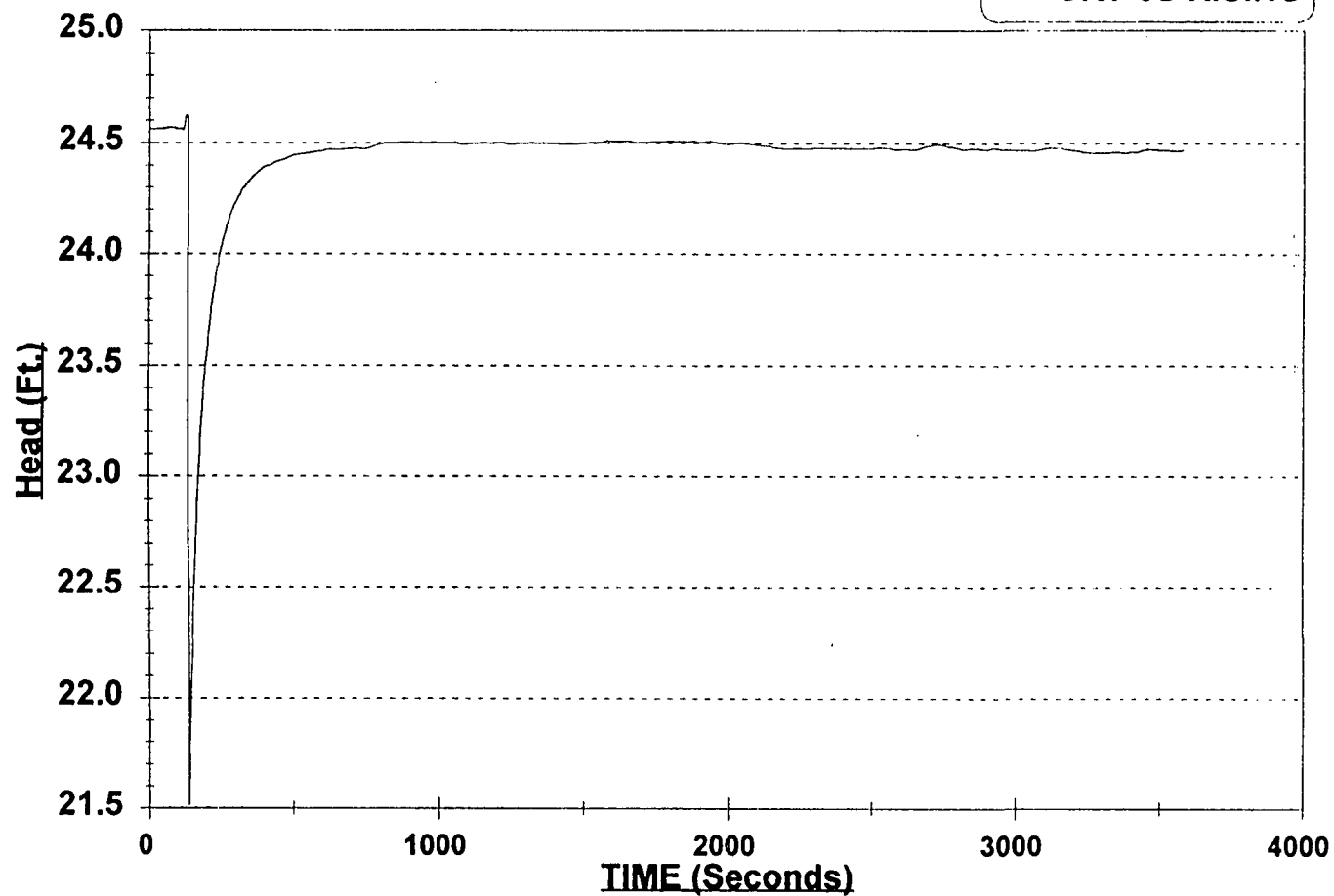
**APPENDIX B**

FIGURE

**4**

## SLUG TEST HYDROGRAPH

— CRT-6S RISING



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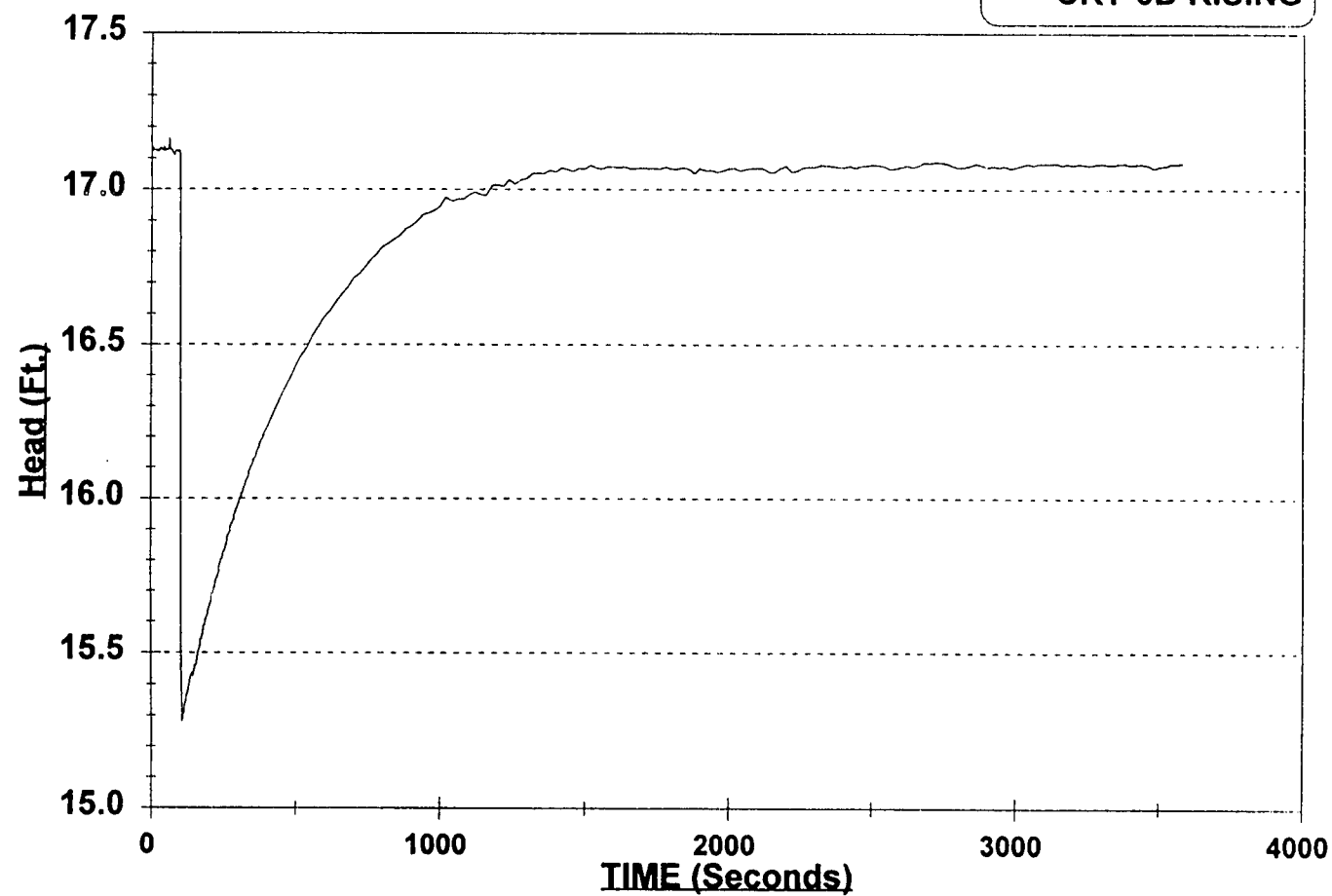
**APPENDIX B**

FIGURE

**5**

## SLUG TEST HYDROGRAPH

CRT-6D RISING



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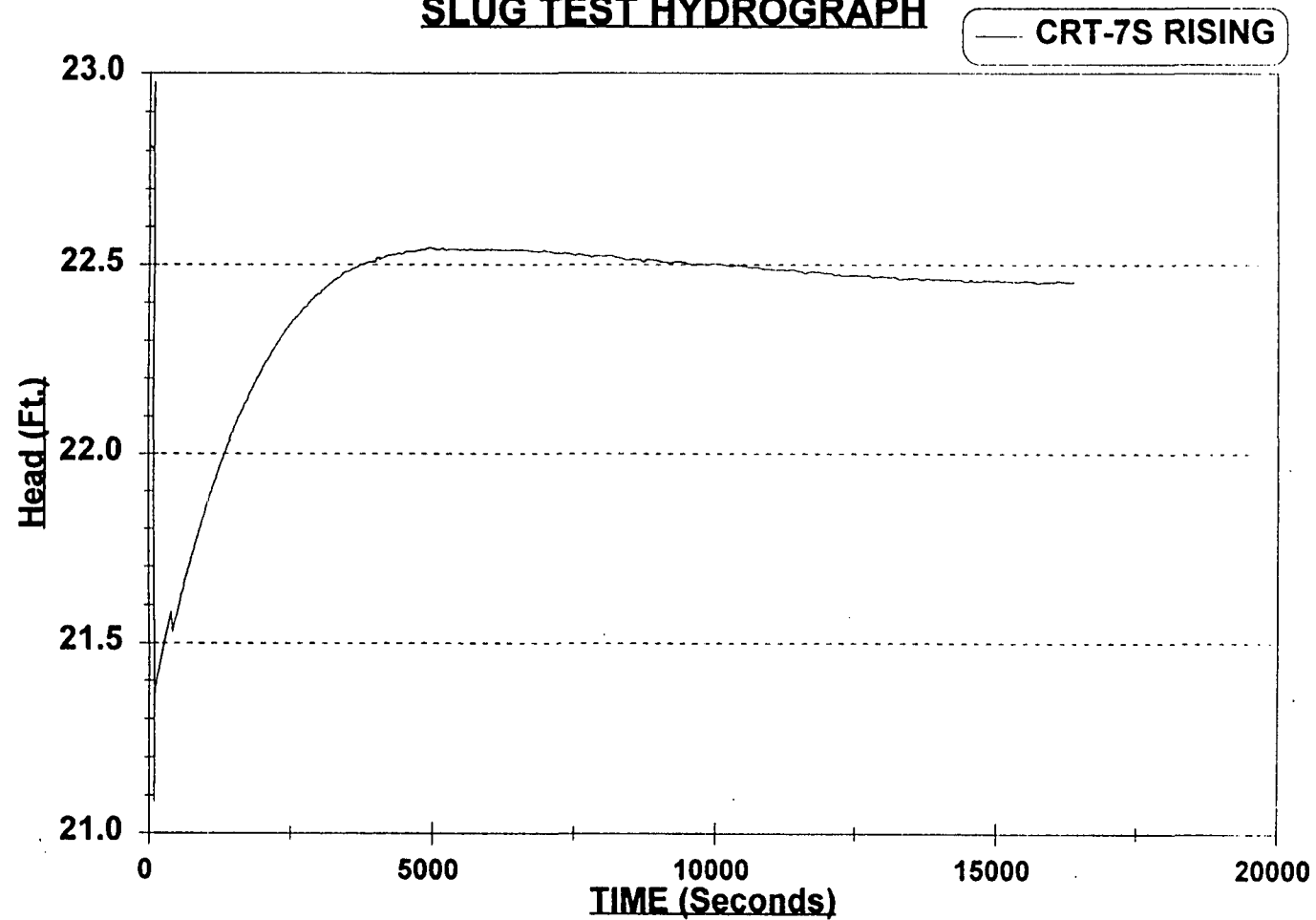
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**APPENDIX B**

FIGURE

**6**

## SLUG TEST HYDROGRAPH



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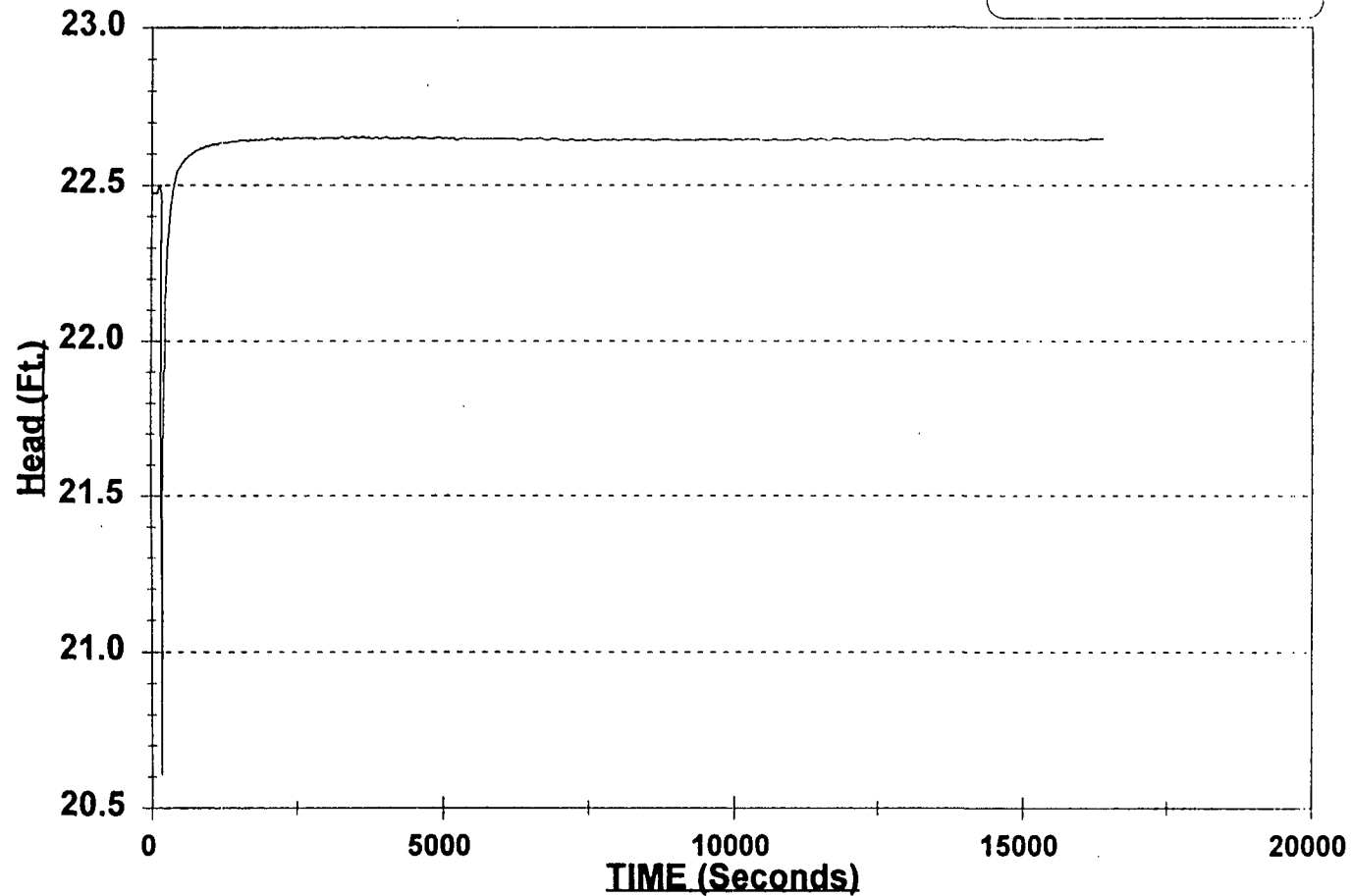
**APPENDIX B**

FIGURE

**7**

## SLUG TEST HYDROGRAPH

— CRT-7D RISING



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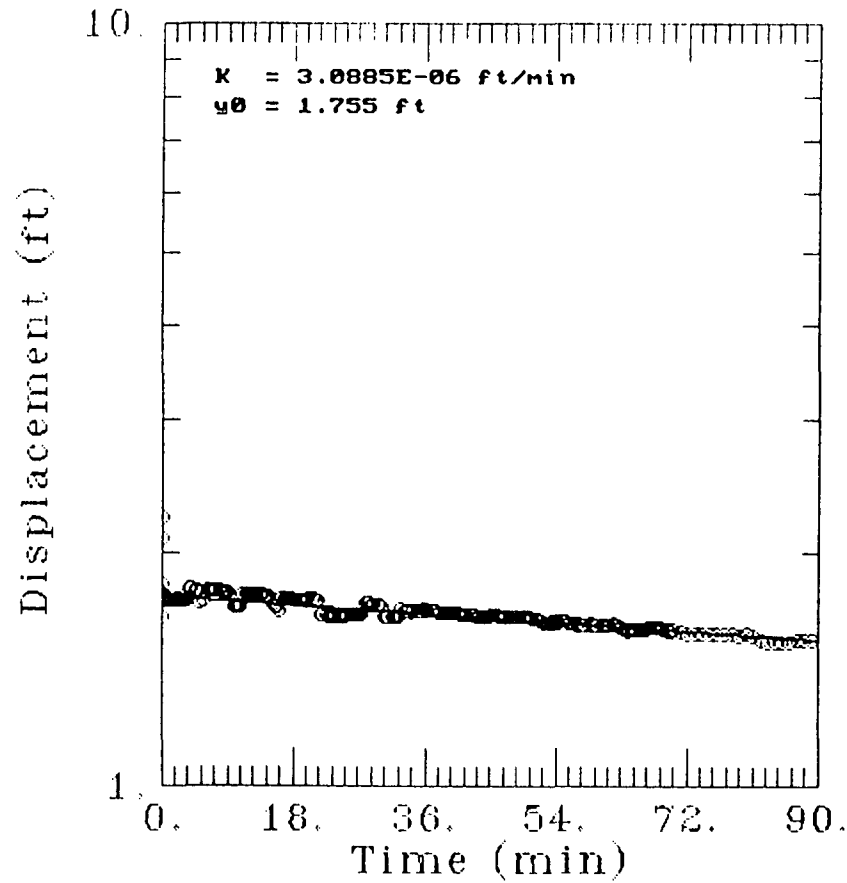
**APPENDIX B**

FIGURE

**8**

**APPENDIX C**  
**Aqtesolv™ Slug Test Data Plots**

# CRT-3S RISING



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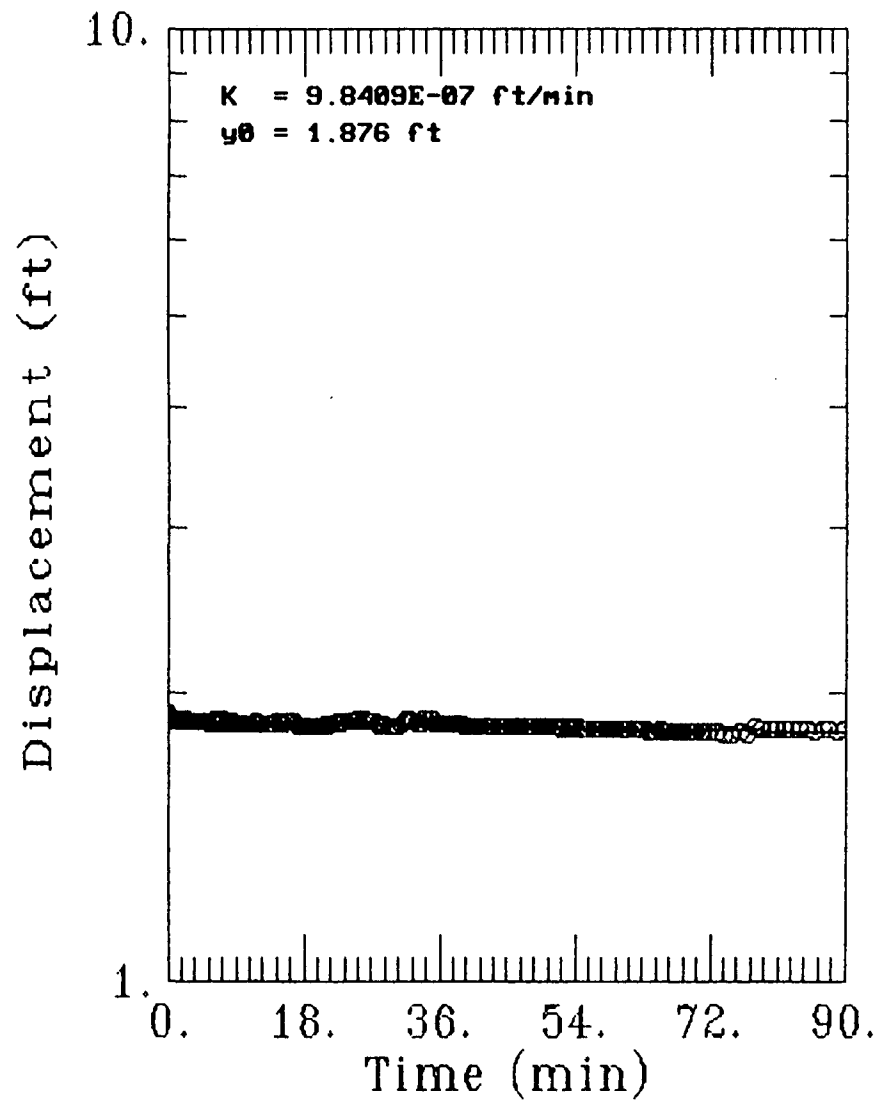
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 REMEDIAL ACTION PLAN ADDENDUM

**APPENDIX C**  
**Aqtesolv<sup>TM</sup> Slug Test**  
**Data Plot for CRT-3S**

FIGURE

1

## CRT-3D RISING



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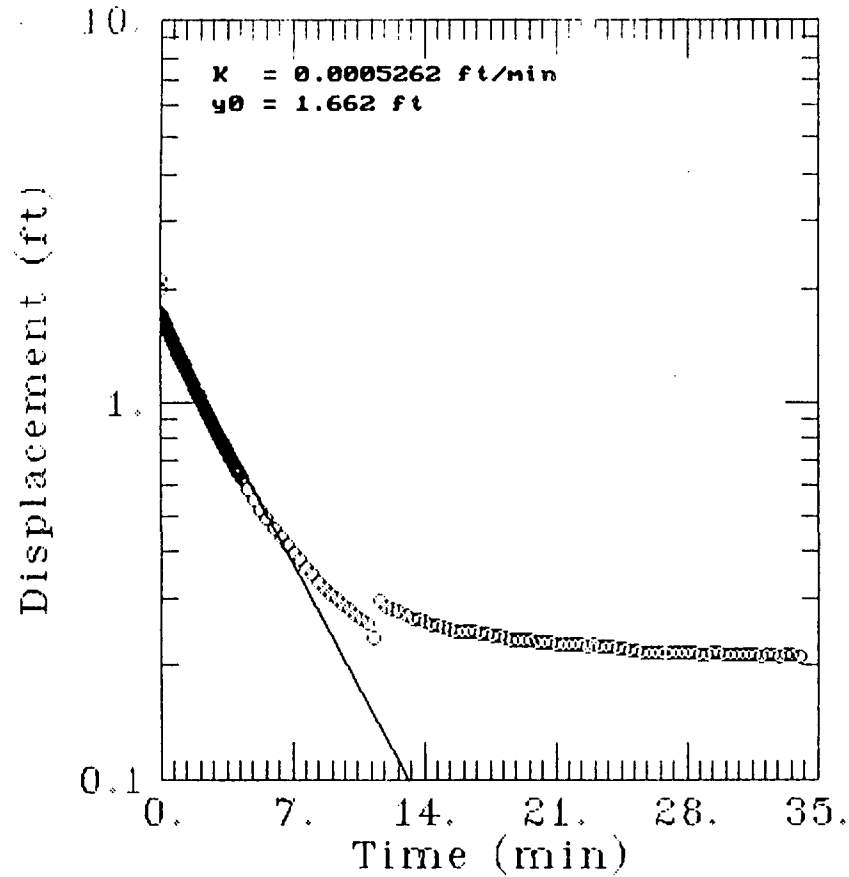
**APPENDIX C**  
**Aqtesolv™ Slug Test**  
**Data Plot for CRT-3D**

FIGURE

**J**



# CRT-4S RISING



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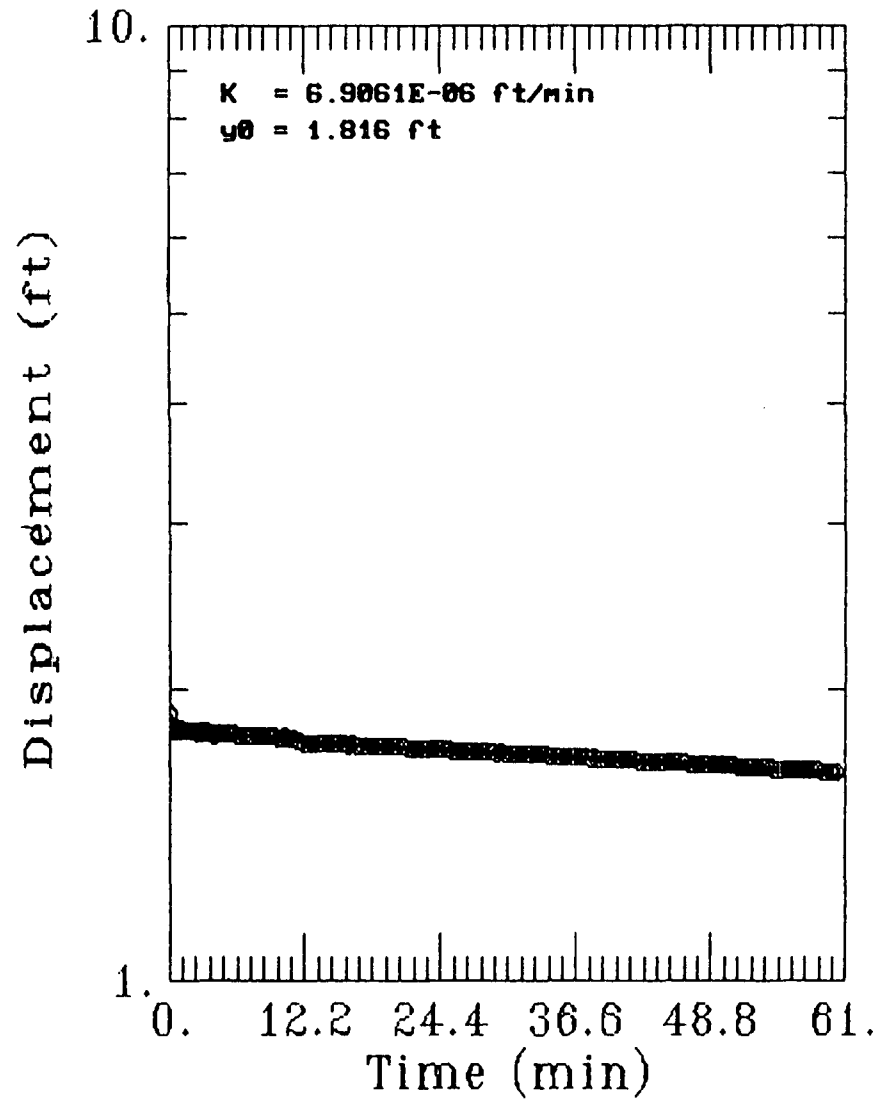
## APPENDIX C

**Aqtesolv<sup>TM</sup> Slug Test  
Data Plot for CRT-4S**

FIGURE

**K**

## CRT-4D RISING



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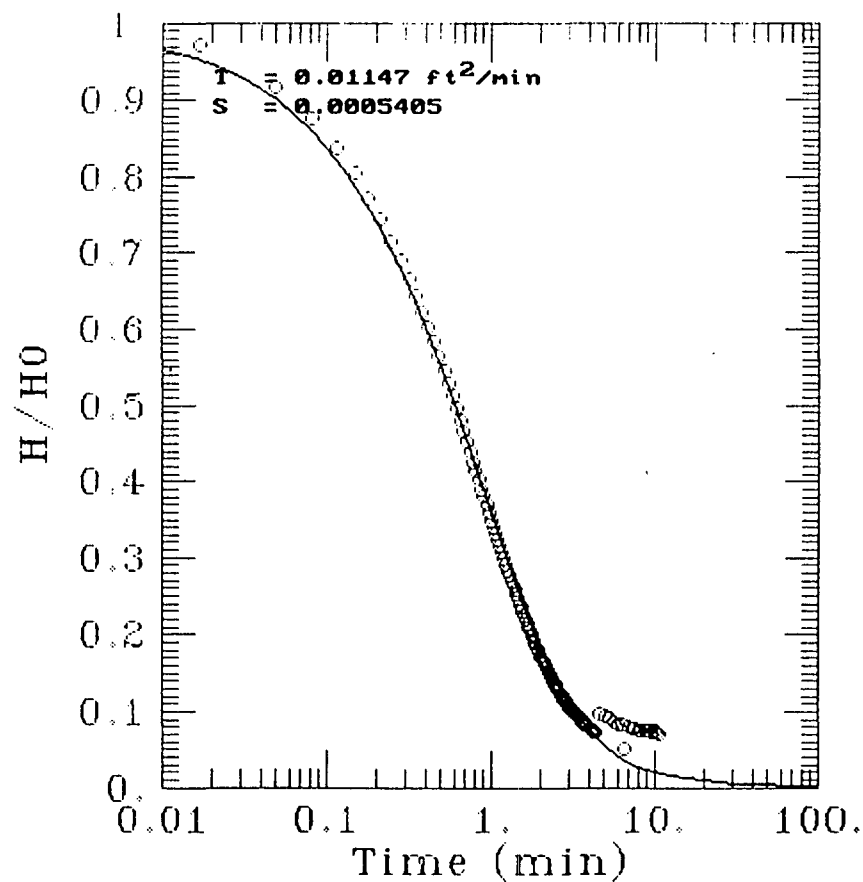
### APPENDIX C

**Aqtesolv<sup>TM</sup> Slug Test  
Data Plot for CRT-4D**

FIGURE

**L**

# CRT-6S RISING



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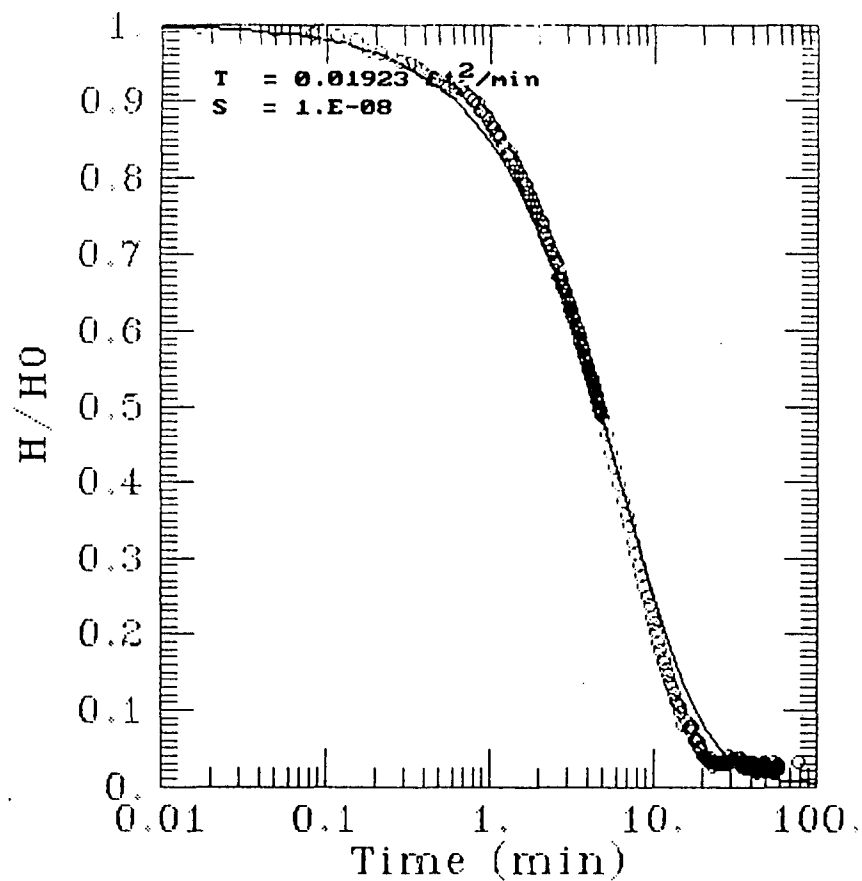
CYTEC INDUSTRIES INC.  
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 CARTERET, NEW JERSEY  
 REMEDIAL ACTION PLAN ADDENDUM

**APPENDIX C**  
**Aqtesolv<sup>TM</sup> Slug Test**  
**Data Plot for CRT-6S**

FIGURE

**M**

## CRT-6D RISING



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CARTERET, NEW JERSEY

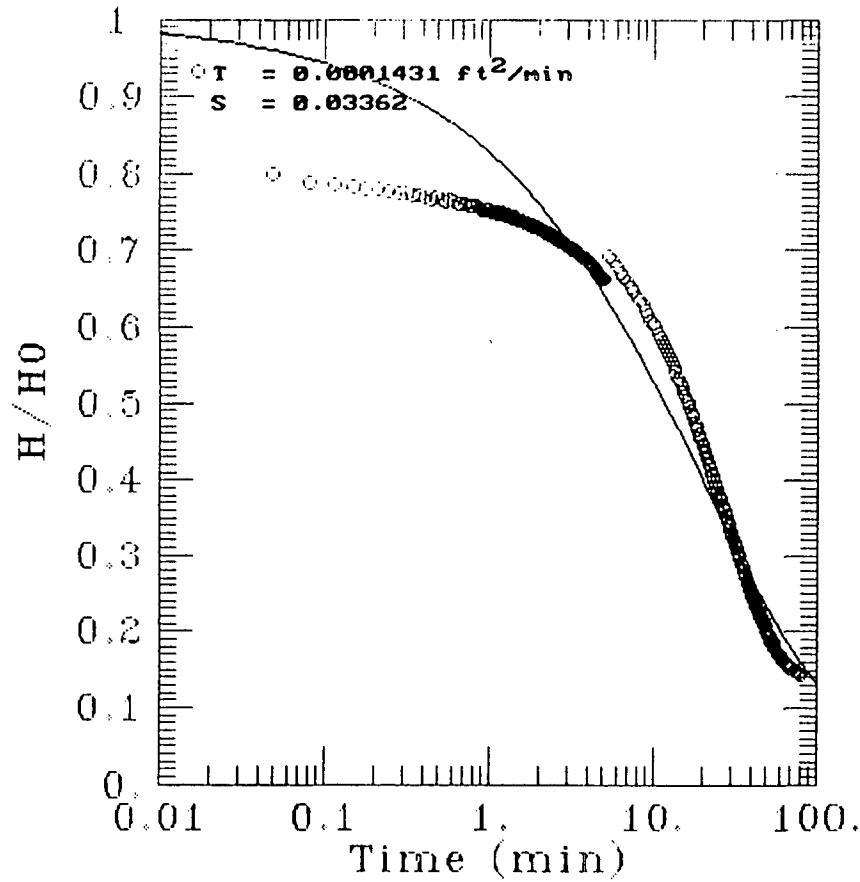
REMEDIAL ACTION PLAN ADDENDUM

**APPENDIX C**  
**Aqtesolv<sup>™</sup> Slug Test**  
**Data Plot for CRT-6D**

FIGURE

**N**

# CRT-7S RISING



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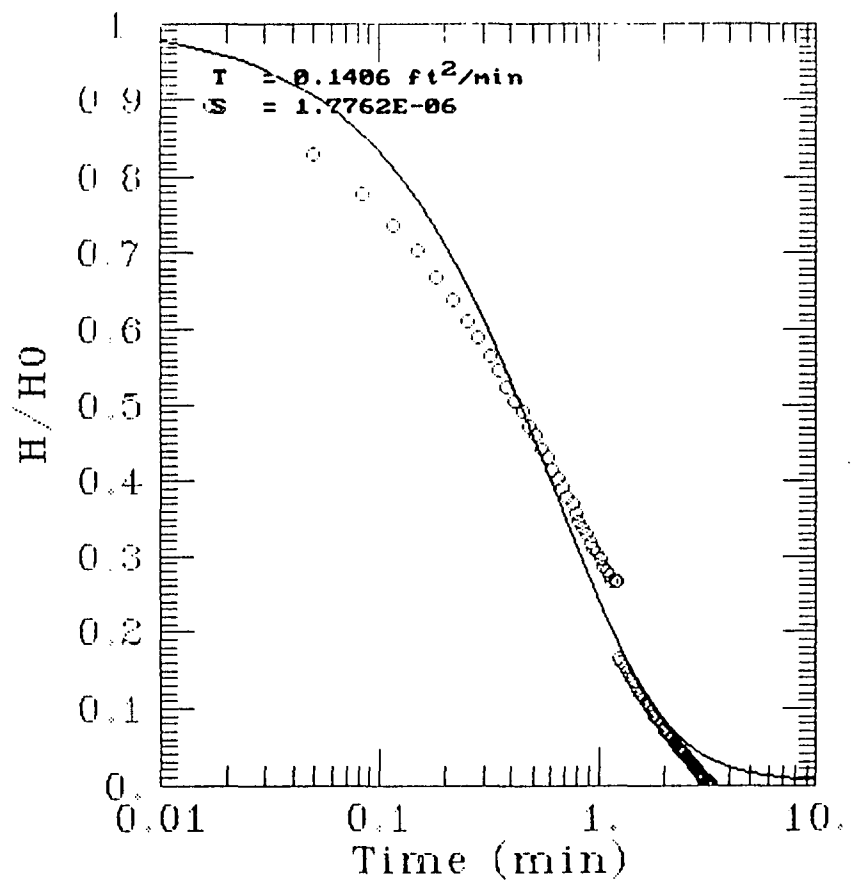
## APPENDIX C

**Aqtesolv<sup>®</sup> Slug Test  
Data Plot for CRT-7S**

FIGURE

**O**

# CRT-7D RISING



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REMEDIAL ACTION PLAN ADDENDUM

**APPENDIX C**  
**Aqtesolv<sup>®</sup> Slug Test**  
**Data Plot for CRT-7D**

FIGURE

**P**

**APPENDIX D**  
**Data Validation Review**

DATA REVIEW FOR  
CYTEC INDUSTRIES, INC.  
CARTERET, NEW JERSEY

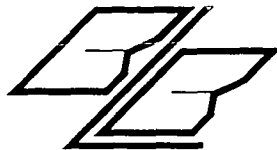
IEA JOB No. 20940-42670/42671

VOLATILE ORGANICS  
AND INORGANICS ANALYSES

Analyses performed by:

IEA  
Whippany, New Jersey

Review performed by:



Blasland, Bouck & Lee, Inc.  
Syracuse, New York



Laurie Johnston (the reviewer) validated the analytical data package using the State of New Jersey Department of Environmental Protection (NJDEP) Standard Operating Procedures for Quality Assurance Data Validation of Analytical Deliverables TAL-Inorganics and TCL-Organics (SOP Nos. 5.A.02 and 5.A.13) as guidelines.

The following is an assessment of select samples from IEA JOB No. 20940-42670/42671 for Cytec Industries, Inc. - Carteret, New Jersey sampling. Included with this assessment are the Target and Nontarget Analyte Summary and the Data Validation Report Forms used in the review of the package. To follow is a review of the following samples:

Sample ID	Sample Number	Sample Type	Sample Date	Analysis			
				VOA	MET	MET (FIL) <sup>2</sup>	INORG <sup>3</sup>
CRT-3S	42670001/20	groundwater	7/13/94	x	x	x	x
CRT-3D	42670002/21	groundwater	7/13/94	x	x	x	x
FB71394	42670003/22	water	7/13/94	x	x	x	x
CRT-4S	42670004/23	groundwater	7/13/94	x	x	x	x
CRT-4D	42670005/24	groundwater	7/13/94	x	x	x	x
CRT-5S	42670006/25	groundwater	7/13/94	x	x	x	x
CRT-5D	42670007/26	groundwater	7/13/94	x	x	x	x
CRT-2S	42670008/27	groundwater	7/14/94	x	x	x	x
CRT-2D	42670009/28	groundwater	7/14/94	x	x	x	x
CRT-1D	42670010/29	groundwater	7/14/94	x	x	x	x
CRT-1S	42670011/30	groundwater	7/14/94	x	x	x	x
BD71494	42670012/31	groundwater	7/14/94	x	x	x	x
CRT-7D	42670013/32	groundwater	7/14/94	x	x	x	x
CRT-7S	42670014/33	groundwater	7/14/94	x	x	x	x
CRT-6S	42670015/34	groundwater	7/14/94	x	x	x	x
CRT-6D	42670016/35	groundwater	7/14/94	x	x	x	x
CRT-8D	42670017/36	groundwater	7/14/94	x	x	x	x
CRT-8S	42670018/37	groundwater	7/14/94	x	x	x	x
FB71494	42670019/38	water	7/14/94	x	x	x	x
TRIP BLANK	42670039	water	--	x			
SW-1	42671001/06	surface water	7/15/94	x	x	x	x
SW-2	42671002/07	surface water	7/15/94	x	x	x	x
SW-BD	42671003/08	surface water	7/15/94	x	x	x	x
SW-3	42671004/09	surface water	7/15/94	x	x	x	x
FB71594	42671005/10	water	7/15/94	x	x	x	x
TB	42671011	water	--	x			

## GENERAL COMMENTS

Since the samples were analyzed using non-CLP methods and reported in a reduced deliverables format, the NJDEP SOPs for data validation were used as guidelines only. Modifications to the procedures were made where necessary to accommodate method and reporting differences.

## VOLATILE ORGANIC FRACTION

Analyses were performed according to USEPA Method 624.

The method specified holding time for volatile analyses of preserved water samples under USEPA 624 is 14 days from sample collection. Samples CRT-3S, CRT-5S and CRT-6S were not preserved. The holding time for aromatic compounds in these samples is 7 days from collection. All samples were analyzed within the specified holding times.

COMMENT: This is a deviation from the 10 day VTSR holding time specified in CLP.

Acetone was detected in the field blank FB71594 and the trip blank TB. No acetone was detected in the associated samples; therefore, no data qualification was necessary.

The method specifies that a performance evaluation standard check be performed daily, prior to the analysis of any standards or samples. Although this is commonly taken to refer to the beginning of each 12 hour shift, for the purposes of this review a 24 hour guideline has been used.

The relative percent difference between recoveries for the surface water matrix spike and matrix spike duplicate was outside specified limits for trichloroethene. No data has been qualified based on the deviation.

The method specifies an initial calibration percent relative standard deviation (%RSD) of 35% for all compounds. The %RSD for all compounds was less than 35%.

COMMENT: This is a deviation from the CLP requirement of a 25% RSD with two allowable outliers.

A continuing calibration check standards must be analyzed daily to verify the working calibration curve. The recovery for each compound in the standard must be within the limits specified within the method. Recoveries were within appropriate difference (%D) of the initial calibration for all compounds.

COMMENT: This is a deviation from the CLP requirement of a 20.5% D with two allowable outliers.

The concentrations were used for the internal standards and surrogates were outside method specifications. No qualification was added to the data based on this deviation.

## INORGANIC (METALS) FRACTION

Analyses were performed according to USEPA 200-series methods.

All calibration, preparation, and field blanks were found to be acceptable, with no analytes detected above the CRQL.

No raw data or information regarding calibration levels or response was provided. Several initial calibration verification (ICV) and continuing calibration verification (CCV) standard recoveries were outside acceptable limits. No analytical sequence information was provided, so no determination of which, if any, samples affected by the barium CCV deviation could be made.

No CRDL standard recovery information was provided, so no assessment of performance at or near the detection limit could be made.

Several matrix spike recoveries were outside acceptable limits, resulting in qualified data.

Several serial dilution percent differences were outside acceptable limits, again, resulting in qualified data.

No raw data or analytical spike recovery information for GFAA analysis was provided; therefore no assessment of GFAA performance could be performed.

Overall system performance was acceptable. Other than those deviations specifically mentioned in this review, the overall data quality is within the guidelines specified in the method.

#### INORGANIC (CONVENTIONAL CHEMISTRY) FRACTION

Analyses were performed according to USEPA methods.

All methods were found to be acceptable, with no analytes detected above the MDL.

All matrix spike recoveries, laboratory control samples recoveries, and laboratory duplicate percent differences were within acceptable limits.

No initial or continuing calibration information was provided; therefore, no assessment of linearity or continuing performance could be made.

Overall system performance was acceptable. Other than those deviations specifically mentioned in this review, the overall data quality is within the guidelines specified in the method.

## Target and Nontarget Analyte Summary

Site: Cytec Industries, Inc. - Carteret, New Jersey  
Medium: Groundwater  
Sample Dates: 7/13/94 - 7/14/94  
Laboratory: IEA - Whippany, NJ

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
<b>FB71394</b>						
	<u>Volatile Organic Fraction ug/l</u>					
	<u>Metals (total) Fraction ug/l</u>					
	Arsenic	**	1.8BN	1.8B		
	Barium	**	0.50U	0.50UJ	qualify	5
	Beryllium	**	0.050U	0.050UJ	qualify	5
	Nickel	**	5.7B	5.7B		
	Potassium	**	125U	125UJ	qualify	5
	Selenium	**	13.7U	---	reject	6
	Thallium	**	1.0U	1.0UJ	qualify	5
	Vanadium	**	3.5U	3.5UJ	qualify	5
	Zinc	**	5.9B	5.9B		
	<u>Metals (filtered) Fraction ug/l</u>					
	Arsenic	**	50.8BN	50.8BJ	qualify	4
	Calcium	**	61.3BE	61.3B		
	Chromium	**	2.0B	2.0B		
	Lead	**	5.9*	5.9J	qualify	8
	Magnesium	**	35.3BE	35.3B		
	Selenium	**	27.4U	---	reject	6
	Sodium	**	267B	267B		
	Zinc	**	4.3B	4.3B		
	<u>Inorganic Fraction mg/l</u>					
	Chloride	3.0U	4.70			
<b>CRT-3D</b>						
	<u>Volatile Organic Fraction ug/l</u>					
	<u>Metals (total) Fraction ug/l</u>					
	Aluminum	**	1780N	---	reject	7
	Arsenic	**	31.6BN	31.6B		
	Barium	**	49.6NE	49.6J	qualify	2
	Beryllium	**	0.64BN	0.64BJ	qualify	2
	Calcium	**	1540000	1540000		
	Chromium	**	1.3B	1.3B		

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Cobalt		**	3.7B	3.7B		
Copper		**	8.7B	8.7B		
Iron		**	19000E	19000J	qualify	1
Lead		**	19.0S	19.0		
Magnesium		**	844000	844000		
Manganese		**	598E	598J	qualify	1
Nickel		**	13.1B	13.1B		
Potassium		**	29000NE	29000J	qualify	1,2
Selenium		**	13.7U	---	reject	6
Sodium		**	4780000E	4780000J	qualify	1
Thallium		**	11.0BN	11.0J	qualify	1
Vanadium		**	6.0BN	6.0J	qualify	2
Zinc		**	65.6	65.6		
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	106	106		
Arsenic		**	20.6U	---	reject	6
Barium		**	36.5NE	36.5		
Beryllium		**	0.16BN	0.16B		
Calcium		**	1750000E	1750000J	qualify	1
Iron		**	9630E	9630J	qualify	1
Lead		**	1.1B*	1.1BJ	qualify	8
Magnesium		**	937000E	937000J	qualify	1
Manganese		**	288E	288J	qualify	1
Potassium		**	29900NE	29900J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	4960000	4960000		
<u>Inorganic Fraction mg/l</u>						
Chloride			3.0U	1400		
Cyanide-Total			0.010U	0.075		
Sulfate			10U	720		
TDS			1.0U	25600		
<b>CRT-3S</b>						
<u>Volatile Organic Fraction ug/l</u>						
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	535N	---	reject	7
Barium		**	147NE	147J	qualify	1,2
Beryllium		**	0.10BN	0.10BJ	qualify	2
Calcium		**	240000	240000		
Iron		**	999E	999J	qualify	1

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Lead		**	2.1B	2.1B		
Magnesium		**	784000	784000		
Manganese		**	42.6E	42.6		
Potassium		**	195000NE	195000J	qualify	1,2
Selenium		**	13.7U	---	reject	6
Sodium		**	5060000E	5060000J	qualify	1
Thallium		**	7.1BN	7.1BJ	qualify	2
Zinc		**	43.2	43.2		
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	33.0BN	33.0B		
Arsenic		**	20.6U	---	reject	6
Barium		**	140NE	140J	qualify	1
Beryllium		**	0.05BN	0.05B		
Calcium		**	225000	225000J	qualify	1
Iron		**	250E	250J	qualify	1
Lead		**	057B	0.57BJ	qualify	8
Magnesium		**	751000	751000J	qualify	1
Manganese		**	37.7E	37.7		
Mercury		**	0.20N	0.20		
Potassium		**	188000NE	188000J	qualify	1
Selenium		**	13.7	---	reject	6
Sodium		**	4820000E	4820000		
Thallium		**	12.9BN	12.9B		
<u>Inorganic Fraction mg/l</u>						
Chloride			3.0U	1300		
Cyanide-Free			0.010U	0.017		
Cyanide-Total			0.010U	0.031		
Sulfate			10U	231		
TDS			1.0U	20900		
<b>CRT-4D</b>						
<u>Volatile Organic Fraction ug/l</u>						
Carbon Disulfide		5U	43	43		
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	248N	---	reject	7
Arsenic		**	9.1B	9.1B		
Barium		**	120NE	120J	qualify	1,2
Beryllium		**	0.28BN	0.28bJ	qualify	2
Calcium		**	703000	703000		
Cobalt		**	28.2	28.2		

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Iron		**	4820E	4820J	qualify	1
Lead		**	2.4B	2.4B		
Magnesium		**	345000	345000		
Manganese		**	96.2E	96.2J	qualify	1
Potassium		**	147000NE	147000J	qualify	1,2
Selenium		**	13.7	---	reject	6
Sodium		**	3580000E	3580000J	qualify	1
Thallium		**	10.0BN	10.0J	qualify	2
Vanadium		**	3.5U	3.5UJ	qualify	5
Zinc		**	25.3	25.3		
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	103	103		
Arsenic		**	73.8BN	73.8J	qualify	4
Barium		**	125NE	125J	qualify	1
Beryllium		**	0.20B	0.20B		
Calcium		**	758000E	758000J	qualify	1
Chromium		**	2.4B	2.4B		
Cobalt		**	29.5	29.5		
Iron		**	917E	917J	qualify	1
Lead		**	5.3U	5.3UJ	qualify	8
Magnesium		**	360000E	360000J	qualify	1
Manganese		**	73.2E	73.2J	qualify	1
Potassium		**	147000NE	147000J	qualify	1
Sodium		**	3670000	3670000		
Zinc		**	10.6	10.6		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	8040			
Cyanide-Free		0.010U	0.098			
Cyanide-Total		0.010U	23.8			
Sulfate		10U	1060			
TDS		1.0U	15800			
<b>CRT-4S</b>						
<u>Volatile Organic Fraction ug/l</u>						
Acetone		10U	29	29		
Carbon disulfide		5U	20	20		
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	131N	---	reject	7
Antimony		**	14.6B	14.6B		
Arsenic		**	60.8BN	60.8B		

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Barium		**	15.5NE	15.5J	qualify	2
Beryllium		**	0.065BN	0.065J	qualify	2
Calcium		**	981000	981000		
Chromium		**	4.9B	4.9B		
Cobalt		**	39.8	39.8		
Iron		**	4280E	4280J	qualify	1
Lead		**	1.8B	1.8B		
Magnesium		**	224000	224000		
Manganese		**	7.2BE	7.2B		
Potassium		**	129000NE	126000J	qualify	1,2
Selenium		**	13.7U	---	reject	6
Sodium		**	5970000E	5970000J	qualify	1
Thallium		**	13.8BN	13.8J	qualify	2
Zinc		**	34.3	34.3		
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	45.3B	45.3		
Antimony		**	20.6BN	20.6BJ	qualify	3
Arsenic		**	33.8BN	33.8BJ	qualify	4
Barium		**	16.9NE	16.9		
Beryllium		**	0.060BN	0.060B		
Calcium		**	1210000E	1210000J	qualify	1
Chromium		**	7.2	7.2		
Cobalt		**	44.1	44.1		
Iron		**	4600E	4600J	qualify	1
Lead		**	1.1U	1.1UJ	qualify	8
Magnesium		**	219000E	219000J	qualify	1
Manganese		**	18.2E	18.2		
Potassium		**	127000NE	127000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	6570000	6570000		
Zinc		**	8.6B	8.6B		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	13700			
Cyanide-Free		0.010U	0.276			
Cyanide-Total		0.010U	18.2			
Sulfate		10U	1590			
TDS		1.0U	26600			



Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
<b>CRT-5D</b>						
<u>Volatile Organic Fraction ug/l</u>						
Carbon Disulfide		5U	2J	2J		
<u>Metals (total) Fraction ug/l</u>						
Aluminum	**		81.8BN	---	reject	7
Arsenic	**		51.2BN	51.2B		
Barium	**		299NE	299J	qualify	1,2
Beryllium	**		0.070BN	0.070BJ	qualify	2
Calcium	**		279000	279000		
Copper	**		3.2B	3.2B		
Iron	**		53400E	53400J	qualify	1
Lead	**		0.75B	0.75B		
Magnesium	**		833000	833000		
Manganese	**		1050E	1050J	qualify	1
Potassium	**		197000NE	197000J	qualify	1,2
Selenium	**		13.7U	---	reject	6
Silver	**		3.7B	3.7B		
Sodium	**		5490000E	5490000J	qualify	1
Thallium	**		8.6BN	8.6BJ	qualify	2
Vanadium	**		9.5BN	9.5BJ	qualify	2
Zinc	**		87.0	87.0		
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum	**		102	102		
Arsenic	**		48.4BN	48.4BJ	qualify	4
Barium	**		161NE	161J	qualify	1
Beryllium	**		0.055BN	0.055B		
Calcium	**		268000E	268000J	qualify	1
Iron	**		13100E	13100J	qualify	1
Lead	**		5.3U	5.3UJ	qualify	8
Magnesium	**		966000E	966000J	qualify	1
Manganese	**		954E	954J	qualify	1
Potassium	**		203000NE	203000J	qualify	1
Selenium	**		27.4	---	reject	6
Sodium	**		6030000	6030000		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	10200			
Cyanide-Free		0.010U	0.053			
Cyanide-Total		0.010U	1.54			
Sulfate		10U	315			

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
TDS		1.0U	21700			
<b>CRT-5S</b>						
	<u>Volatile Organic Fraction ug/l</u>					
	<u>Metals (total) Fraction ug/l</u>					
Aluminum	**	1160N	---	reject	7	
Barium	**	177NE	177J	qualify	1,2	
Beryllium	**	0.11BN	0.11BJ	qualify	2	
Calcium	**	305000	305000			
Iron	**	1860E	1860J	qualify	1	
Lead	**	5.3	5.3			
Magnesium	**	992000	992000			
Manganese	**	23.1E	23.1			
Mercury	**	0.31N	0.31J	qualify	3	
Potassium	**	230000NE	230000J	qualify	1,2	
Selenium	**	13.7U	---	reject	6	
Sodium	**	6230000E	6230000J	qualify	1	
Thallium	**	11.0BN	11.0BJ	qualify	2	
Vanadium	**	7.6BN	7.6BJ	qualify	2	
Zinc	**	19.3	19.3			
	<u>Metals (filtered) Fraction ug/l</u>					
Aluminum	**	25.4B	25.4B			
Arsenic	**	21.2BN	21.2BJ	qualify	4	
Barium	**	155NE	155J	qualify	1	
Beryllium	**	0.065BN	0.065B			
Calcium	**	284000E	284000J	qualify	1	
Iron	**	344E	344J	qualify	1	
Lead	**	5.3U	5.3UJ	qualify	8	
Magnesium	**	1130000E	1130000J	qualify	1	
Manganese	**	11.5E	11.5			
Potassium	**	224000NE	224000J	qualify	1	
Selenium	**	27.4U	---	reject	6	
Sodium	**	6490000	6490000			
Vanadium	**	5.0B	5.0B			
	<u>Inorganic Fraction mg/l</u>					
Chloride		3.0U	7540			
Cyanide-Free		0.010U	0.034			
Cyanide-Total		0.010U	1.26			
Sulfate		10U	138			
TDS		1.0U	24800			

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
FB71494 (field blank)						
	Volatile Organic Fraction ug/l					
	Metals (total) Fraction ug/l					
Barium	**		0.50U	0.50UJ	qualify	5
Beryllium	**		0.050U	0.050UJ	qualify	5
Potassium	**		125U	125UJ	qualify	5
Selenium	**		1.4U	---	reject	6
Sodium	**		148BE	148B		
Thallium	**		1.0U	1.0UJ	qualify	5
Vanadium	**		3.5U	3.5UJ	qualify	5
Zinc	**		6.3B	6.3B		
	Metals (filtered) Fraction ug/l					
Aluminum	**		16.0B	16.0B		
Arsenic	**		1.0U	---	reject	6
Beryllium	**		0.055BN	0.055B		
Calcium	**		58.4BE	58.4B		
Chromium	**		2.3B	2.3B		
Copper	**		7.9B	7.9B		
Iron	**		26.1BE	26.1B		
Lead	**		1.1U	1.1UJ	qualify	8
Magnesium	**		82.0BE	82.0B		
Manganese	**		1.4BE	1.4B		
Potassium	**		132BNE	132B		
Selenium	**		27.4U	---	reject	6
Sodium	**		621	621		
Zinc	**		9.7B	9.7B		
	Inorganic Fraction mg/l					
TRIP BLANK						
	Volatile Organic Fraction ug/l					
BD71494 (duplicate of CRT-1S)						
	Volatile Organic Fraction ug/l					
Acetone		10U	53	53		
Benzene		1U	46	46		
Chlorobenzene		4U	5	5		
Xylenes (total)		5U	9	9		
	Metals (total) Fraction ug/l					
Aluminum	**		1590N	---	reject	7
Arsenic	**		2.7BN	2.7B		
Barium	**		1010NE	1010J	qualify	1,2

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Beryllium		**	2.4BN	2.4BJ	qualify	2
Calcium		**	264000	264000		
Cobalt		**	3.4B	3.4B		
Copper		**	3.2B	3.2B		
Iron		**	96400E	96400J	qualify	1
Lead		**	8.1	8.1		
Magnesium		**	233000	233000		
Manganese		**	2220E	2220J	qualify	1
Potassium		**	45400NE	45400J	qualify	1,2
Selenium		**	13.7	---	reject	6
Silver		**	12.1	12.1		
Sodium		**	1950000E	1950000J	qualify	1
Thallium		**	14.0BN	14.0BJ	qualify	2
Vanadium		**	30.3N	30.3J	qualify	2
Zinc		**	17.3	17.3		
<u>Metals (filtered) ug/l</u>						
Aluminum		**	266	266		
Arsenic		**	20.6U	---	reject	6
Barium		**	945NE	945J	qualify	1
Beryllium		**	0.25BN	0.25B		
Calcium		**	284000E	284000J	qualify	1
Chromium		**	1.4B	1.4B		
Cobalt		**	3.7B	3.7B		
Iron		**	40500E	40500J	qualify	1
Magnesium		**	244000E	244000J	qualify	1
Manganese		**	2410E	2410J	qualify	1
Potassium		**	49600NE	49600J	qualify	1
Selenium		**	27.4U	---	reject	6
Silver		**	4.2B	4.2B		
Sodium		**	2240000	2240000		
Vanadium		**	9.6B	9.6B		
Zinc		**	6.2B	6.2B		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	4620			
Cyanide-Total		0.010U	0.036			
Sulfate		10U	95.8			
TDS		1.0U	10200			

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
<b>CRT-1D</b>						
	<u>Volatile Organic Fraction ug/l</u>					
	<u>Metals (total) Fraction ug/l</u>					
	Aluminum	**	113N	---	reject	7
	Barium	**	50.6NE	50.6J	qualify	1,2
	Beryllium	**	0.47BN	0.47BJ	qualify	2
	Cadmium	**	2.2B	2.2B		
	Calcium	**	2180000	2180000		
	Copper	**	18.6	18.6		
	Iron	**	56000E	56000J	qualify	1
	Lead	**	5.6	5.6		
	Magnesium	**	597000	597000		
	Manganese	**	2620E	2620J	qualify	1
	Mercury	**	0.33N	0.33J	qualify	3
	Potassium	**	17800NE	17800J	qualify	1,2
	Selenium	**	13.7U	---	reject	6
	Silver	**	5.4	5.4		
	Sodium	**	3160000E	3160000J	qualify	1
	Thallium	**	7.8B	7.8BJ	qualify	2
	Vanadium	**	8.1B	8.1BJ	qualify	2
	Zinc	**	168	168		
	<u>Metals (filtered) Fraction ug/l</u>					
	Aluminum	**	140	140		
	Arsenic	**	44.8BN	44.8BJ	qualify	4
	Barium	**	39.7NE	39.7		
	Beryllium	**	0.30BN	0.30B		
	Calcium	**	2460000E	2460000J	qualify	1
	Iron	**	564E	564J	qualify	1
	Lead	**	1.1U	1.1UJ	qualify	8
	Magnesium	**	665000E	665000J	qualify	1
	Manganese	**	1210E	1210J	qualify	1
	Potassium	**	19900NE	19900J	qualify	1
	Selenium	**	27.4U	---	reject	6
	Sodium	**	3000000	300000		
	Thallium	**	10.1BN	10.1B		
	Zinc	**	48.3	48.3		
	<u>Inorganic Fraction mg/l</u>					
	Chloride	3.0U	9680			
	Sulfate	10U	381			

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
TDS		1.0U	22400			
<b>CRT-1S</b>						
<u>Volatile Organic Fraction ug/l</u>						
Acetone		10U	63	63		
Benzene		1U	45	45		
Chlorobenzene		4U	5	5		
Xylenes (total)		5U	8	8		
<u>Metals (total) Fraction ug/l</u>						
Aluminum	**	2010N	---	reject		
Barium	**	1060NE	1060J	qualify		1,2
Beryllium	**	3.0N	3.0J	qualify		2
Calcium	**	278000	278000			
Chromium	**	2.2B	2.2B			
Cobalt	**	3.0B	3.0B			
Copper	**	3.4B	3.4B			
Iron	**	112000E	112000J	qualify		1
Lead	**	6.8	6.8			
Magnesium	**	242000	242000			
Manganese	**	2430E	2430J	qualify		1
Mercury	**	0.27N	0.27J	qualify		3
Potassium	**	44700NE	44700J	qualify		1,2
Selenium	**	13.7U	---	reject		6
Silver	**	14.4	14.4			
Sodium	**	2060000E	2060000J	qualify		1
Thallium	**	8.6BN	8.6BJ	qualify		2
Vanadium	**	32.4N	32.4J	qualify		2
Zinc	**	50.0	50.0			
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum	**	566	566			
Arsenic	**	10.7U	---	reject		6
Barium	**	963NE	963J	qualify		1
Beryllium	**	0.57BN	0.57B			
Calcium	**	296000E	296000J	qualify		1
Chromium	**	2.5B	2.5B			
Cobalt	**	4.6B	4.6B			
Iron	**	43000E	43000J	qualify		1
Lead	**	1.1U	1.1UJ	qualify		8
Magnesium	**	251000E	251000J	qualify		1
Manganese	**	2520E	2520J	qualify		1

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Potassium		**	49000NE	49000J	qualify	1
Selenium		**	27.4U	---	reject	6
Silver		**	4.5B	4.5B		
Sodium		**	2160000	2160000		
Thallium		**	8.6BN	8.6B		
Vanadium		**	11.2B	11.2B		
Zinc		**	2.3B	2.3B		
<u>Inorganic Fraction mg/l</u>						
Chloride			3.0U	12300		
Cyanide-Total			0.010U	0.033		
Sulfate			10U	144		
TDS			1.0U	9960		
<b>CRT-2D</b>						
<u>Volatile Organic Fraction ug/l</u>						
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	152N	---	reject	7
Barium		**	62.1NE	62.1J	qualify	1,2
Beryllium		**	0.10BN	0.10BJ	qualify	2
Calcium		**	624000	624000		
Copper		**	4.1B	4.1B		
Iron		**	16000E	16000J	qualify	1
Lead		**	4.2	4.2		
Magnesium		**	669000	669000		
Manganese		**	836E	836J	qualify	1
Mercury		**	0.34N	0.34J	qualify	3
Potassium		**	75200NE	75200J	qualify	2
Selenium		**	13.7U	---	reject	6
Sodium		**	4460000E	4460000J	qualify	1
Thallium		**	15.9B	15.9BJ	qualify	2
Vanadium		**	3.5U	3.5UJ	qualify	5
Zinc		**	40.1	40.1		
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	35.2B	35.2B		
Arsenic		**	20.6U	---	reject	6
Barium		**	55.8NE	55.8J	qualify	1
Beryllium		**	0.075BN	0.075B		
Calcium		**	690000E	690000J	qualify	1
Iron		**	5220E	5220J	qualify	1
Lead		**	5.3U	5.3UJ	qualify	8

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
	Magnesium	**	747000E	747000J	qualify	1
	Manganese	**	597E	597J	qualify	1
	Potassium	**	124000NE	124000J	qualify	1
	Selenium	**	27.4U	---	reject	6
	Sodium	**	4730000	4730000		
	Thallium	**	13.9BN	13.8B		
	<u>Inorganic Fraction mg/l</u>					
	Chloride	3.0U	10600			
	Cyanide-Free	0.010U	0.013			
	Cyanide-Total	0.010U	0.133			
	Sulfate	10U	852			
	TDS	1.0U	19500			
	<b>CRT-2S</b>					
	<u>Volatile Organic Fraction ug/l</u>					
	Carbon disulfide	5U	1J	1J		
	<u>Metals (total) Fraction ug/l</u>					
	Aluminum	**	749N	---	reject	7
	Arsenic	**	3.2BN	3.2B		
	Barium	**	171NE	171J	qualify	1,2
	Beryllium	**	0.13BN	0.13BJ	qualify	2
	Calcium	**	622000	622000		
	Chromium	**	4.1B	4.1B		
	Cobalt	**	3.2B	3.2B		
	Copper	**	6.7B	6.7B		
	Iron	**	3170E	3170J	qualify	1
	Lead	**	4.5	4.5		
	Magnesium	**	246000	246000		
	Manganese	**	613E	613J	qualify	1
	Mercury	**	0.24N	0.24J	qualify	3
	Nickel	**	6.2B	6.2B		
	Potassium	**	21700NE	21700J	qualify	1,2
	Selenium	**	13.7U	---	reject	6
	Sodium	**	2080000E	2080000J	qualify	1
	Thallium	**	1.0U	1.0UJ	qualify	5
	Vanadium	**	3.5U	3.5UJ	qualify	5
	Zinc	**	43.1	43.1		
	<u>Metals (filtered) Fraction ug/l</u>					
	Aluminum	**	276	276		
	Arsenic	**	20.6U	---	reject	6



Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Barium		**	181NE	181J	qualify	1
Beryllium		**	0.075BN	0.075B		
Calcium		**	714000E	714000J	qualify	1
Chromium		**	1.8B	1.8B		
Cobalt		**	3.2B	3.2B		
Iron		**	2040E	2040J	qualify	1
Lead		**	1.1U	1.1UJ	qualify	8
Magnesium		**	262000E	262000J	qualify	1
Manganese		**	651E	651J	qualify	1
Potassium		**	23800NE	23800J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	2190000	2190000		
Thallium		**	9.2BN	9.2B		
Zinc		**	23.3	23.3		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	5110			
Cyanide-Free		0.010U	0.035			
Cyanide-Total		0.010U	1.56			
Sulfate		10U	690			
TDS		1.0U	8740			
<b>CRT-6D</b>						
<u>Volatile Organic Fraction ug/l</u>						
Acetone		10U	7J	7J		
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	73.5BN	---	reject	7
Barium		**	33.7NE	33.7J	qualify	2
Beryllium		**	0.16BN	0.16BJ	qualify	2
Calcium		**	921000	921000		
Iron		**	7570E	7570J	qualify	1
Lead		**	2.6B	2.6B		
Magnesium		**	735000	735000		
Manganese		**	631E	631J	qualify	1
Potassium		**	41600NE	41600J	qualify	1,2
Selenium		**	13.7U	---	reject	6
Sodium		**	3820000E	3820000J	qualify	1
Thallium		**	10.8BN	10.8BJ	qualify	2
Vanadium		**	3.5U	3.5UJ	qualify	5
Zinc		**	7.1B	7.1B		

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	97.1B	97.1B		
Antimony		**	19.1BN	19.1BJ	qualify	3
Arsenic		**	20.6U	---	reject	6
Barium		**	33.1NE	33.1		
Beryllium		**	0.18BN	0.18B		
Calcium		**	1100000E	1100000J	qualify	1
Iron		**	7520E	7520J	qualify	1
Lead		**	1.2B*	1.2BJ	qualify	8
Magnesium		**	880000E	880000J	qualify	1
Manganese		**	656E	656J	qualify	1
Potassium		**	47100NE	47100J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	4300000	4300000		
Zinc		**	20.3	20.3		
<u>Inorganic Fraction mg/l</u>						
Chloride			3.0U	10600		
Cyanide-Total			0.010U	0.025		
Sulfate			10U	426		
TDS			1.0U	21600		
<b>CRT-6S</b>						
<u>Volatile Organic Fraction ug/l</u>						
Acetone			10U	9J	9J	
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	357N	---	reject	7
Arsenic		**	24.8BN	24.8B		
Barium		**	310NE	310J	qualify	1,2
Beryllium		**	0.060BN	0.060BJ	qualify	2
Calcium		**	298000	298000		
Copper		**	6.7B	6.7B		
Iron		**	3900E	3900J	qualify	1
Lead		**	3.9	3.9		
Magnesium		**	753000	753000		
Manganese		**	553E	553J	qualify	1
Nickel		**	5.7B	5.7B		
Potassium		**	175000NE	175000J	qualify	1,2
Selenium		**	13.7U	---	reject	6
Sodium		**	4520000E	4520000J	qualify	1
Thallium		**	5.9BN	5.8BJ	qualify	2

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Vanadium		**	3.5U	3.5UJ	qualify	5
Zinc		**	20.7	20.7		
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	74.2B	74.2B		
Antimony		**	20.6BN	20.6BJ	qualify	3
Arsenic		**	20.6U	---	reject	6
Barium		**	300NE	300J	qualify	1
Beryllium		**	0.065BN	0.065B		
Calcium		**	300000E	300000J	qualify	1
Iron		**	3160E	3160J	qualify	1
Lead		**	9.6*	9.6J	qualify	8
Magnesium		**	925000E	925000J	qualify	1
Manganese		**	436E	436J	qualify	1
Potassium		**	146000NE	146000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	4770000	4770000		
Thallium		**	9.4BN	9.4B		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	10300			
Cyanide-Free		0.010U	0.048			
Cyanide-Total		0.010U	0.304			
Sulfate		10U	330			
TDS		1.0U	19400			
<b>CRT-7D</b>						
<u>Volatile Organic Fraction ug/l</u>						
Acetone		10U	6J	6J		
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	745N	---	reject	7
Barium		**	58.0NE	58.0J	qualify	1,2
Beryllium		**	0.39BN	0.39BJ	qualify	2
Calcium		**	1640000	1640000		
Copper		**	2.2B	2.2B		
Iron		**	33000E	33000J	qualify	1
Lead		**	3.9	3.9		
Magnesium		**	641000	641000		
Manganese		**	877E	877J	qualify	1
Potassium		**	19900NE	19900J	qualify	1,2
Selenium		**	13.7U	---	reject	6
Silver		**	2.7B	2.7B		

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Sodium		**	3710000E	3710000J	qualify	1
Thallium		**	12.0BN	12.0BJ	qualify	2
Vanadium		**	3.5BN	3.5BJ	qualify	2
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	194	194		
Arsenic		**	33.8BN	33.8BJ	qualify	4
Barium		**	50.5NE	50.5J	qualify	1
Beryllium		**	0.53BN	0.53B		
Calcium		**	1750000E	1750000J	qualify	1
Iron		**	29000E	29000J	qualify	1
Magnesium		**	674000E	674000J	qualify	1
Manganese		**	831E	831J	qualify	1
Potassium		**	20500NE	20500J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	3470000	3470000		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	9510			
Sulfate		10U	366			
TDS		1.0U	27200			
<b>CRT-7S</b>						
<u>Volatile Organic Fraction ug/l</u>						
Acetone		10U	26	26		
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	152N	---	reject	7
Barium		**	305NE	305J	qualify	1,2
Beryllium		**	0.060BN	0.060BJ	qualify	2
Calcium		**	230000	230000		
Chromium		**	33.6	33.6		
Iron		**	4300E	4300J	qualify	1
Lead		**	3.0	3.0		
Magnesium		**	702000	702000		
Manganese		**	1210E	1210J	qualify	1
Potassium		**	214000NE	214000J	qualify	1,2
Selenium		**	13.7U	---	reject	6
Sodium		**	4750000E	4750000J	qualify	1
Thallium		**	17.3BN	17.3BJ	qualify	2
Vanadium		**	3.5U	3.5UJ	qualify	5
Zinc		**	45.3	45.3		

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	130	130		
Arsenic		**	20.6U	---	reject	6
Barium		**	295NE	295J	qualify	1
Beryllium		**	0.28BN	0.28B		
Calcium		**	230000E	230000		
Chromium		**	17.8	17.8		
Iron		**	489E	489J	qualify	1
Magnesium		**	849000E	849000J	qualify	1
Manganese		**	1200E	1200J	qualify	1
Potassium		**	186000NE	186000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	5000000	5000000		
Thallium		**	10.3BN	10.3B		
Vanadium		**	9.6B	9.6B		
<u>Inorganic Fraction mg/l</u>						
Chloride			3.0U	9420		
Cyanide-Free			0.010U	0.116		
Cyanide-Total			0.010U	0.290		
Sulfate			10U	228		
TDS			1.0U	19500		
<b>CRT-8D</b>						
<u>Volatile Organic Fraction ug/l</u>						
Acetone			10U	8J	8J	
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	64.5BN	---	reject	7
Barium		**	49.9NE	49.9J	qualify	2
Beryllium		**	0.075BN	0.075BJ	qualify	2
Calcium		**	337000	337000		
Iron		**	933E	933J	qualify	1
Lead		**	1.4B	1.4B		
Magnesium		**	723000	723000		
Manganese		**	522E	522J	qualify	1
Potassium		**	75600NE	75600J	qualify	1,2
Selenium		**	13.7U	---	reject	6
Sodium		**	5350000E	5350000J	qualify	1
Thallium		**	5.3BN	5.3BJ	qualify	2
Vanadium		**	3.5U	3.5UJ	qualify	5
Zinc		**	31.4	31.4		

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	102	102		
Antimony		**	16.5BN	16.5BJ	qualify	3
Arsenic		**	22.4BN	22.4BJ	qualify	4
Barium		**	48.7NE	48.7		
Beryllium		**	0.055BN	0.055B		
Calcium		**	328000E	328000J	qualify	1
Iron		**	399E	399J	qualify	1
Lead		**	1.1U	1.1UJ	qualify	8
Magnesium		**	760000E	760000J	qualify	1
Manganese		**	516E	516J	qualify	1
Potassium		**	125000NE	125000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	5460000	5460000		
Thallium		**	10.4BN	10.4B		
Zinc		**	37.9	37.9		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	13000			
Sulfate		10U	249			
TDS		1.0U	20200			
<b>CRT-8S</b>						
<u>Volatile Organic Fraction ug/l</u>						
Acetone		10U	9J	9J		
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	472N	---	reject	
Arsenic		**	45.0BN	45.0B		
Barium		**	205NE	205J	qualify	1,2
Beryllium		**	0.075BN	0.075BJ	qualify	2
Calcium		**	357000	357000		
Cobalt		**	6.8B	6.8B		
Copper		**	8.9B	8.9B		
Iron		**	1740E	1740J	qualify	1
Lead		**	1.8B	1.8B		
Magnesium		**	806000	806000		
Manganese		**	3690E	3690J	qualify	1
Mercury		**	0.23N	0.23J	qualify	3
Nickel		**	5.8B	5.8B		
Potassium		**	152000NE	152000J	qualify	1,2
Selenium		**	13.7U	---	reject	6

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Sodium		**	5020000E	5020000J	qualify	1
Thallium		**	10.2BN	10.2BJ	qualify	2
Vanadium		**	3.5U	3.5UJ	qualify	5
Zinc		**	18.5	18.5		
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	56.0B	56.0B		
Antimony		**	23.9BN	23.9BJ	qualify	3
Arsenic		**	20.6U	---	reject	6
Barium		**	214NE	214J	qualify	1
Calcium		**	366000E	366000J	qualify	1
Cobalt		**	7.0B	7.0B		
Iron		**	909E	909J	qualify	1
Magnesium		**	898000E	898000J	qualify	1
Manganese		**	3770E	3770J	qualify	1
Potassium		**	152000NE	152000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	5360000	5260000		
Thallium		**	8.7BN	8.7B		
Zinc		**	3.5B	3.5B		
<u>Inorganic Fraction mg/l</u>						
Chloride			3.0U	11600		
Cyanide-Total			0.010U	0.180		
Sulfate			10U	373		
TDS			1.0U	21400		

\* Only those analytes that were detected or which require qualification are listed. Please refer to the analytical data for further information.

\*\* No inorganic preparation logs or analytical sequence information provided in the data package. An association of blanks with individual samples is not possible.

Site: Cytex Industries, Inc. - Carteret, New Jersey  
Medium: Surface Water  
Sample Dates: 7/15/94  
Laboratory: IEA - Whippany, NJ

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
<b>FB71594</b>						
	<u>Volatile Organic Fraction ug/l</u>					
Acetone		10U	5J	5J		
	<u>Metals (total) Fraction ug/l</u>					
Arsenic		**	10.7U	---	reject	6
Barium		**	0.50U	0.50UJ	qualify	5
Calcium		**	37.5B	37.5B		
Iron		**	6.4BNE	6.4BJ	qualify	2
Magnesium		**	24.4B	24.4B		
Selenium		**	13.7U	---	reject	6
Sodium		**	71.0BE	71.0B		
Zinc		**	1.8U	1.8UJ	qualify	8
	<u>Metals (filtered) Fraction ug/l</u>					
Arsenic		**	1.2BN	1.2B		
Calcium		**	110B	110B		
Chromium		**	5.9	5.9		
Iron		**	48.9BNE	48.9B		
Magnesium		**	97.0BE	97.0B		
Manganese		**	2.0BE	2.0B		
Potassium		**	287BE	287B		
Sodium		**	550E	550		
Thallium		**	9.3B	9.3B		
	<u>Inorganic Fraction mg/l</u>					
Chloride		3.0U	10.1			
<b>TB</b>						
	<u>Volatile Organic Fraction ug/l</u>					
Acetone		10U	6J	6J		
<b>SW-1</b>						
	<u>Volatile Organic Fraction ug/l</u>					
	<u>Metals (total) Fraction ug/l</u>					



Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Aluminum		**	276	276		
Antimony		**	11.4BN	11.4BJ	qualify	4
Barium		**	49.5NE	49.5J	qualify	2
Calcium		**	201000	201000		
Copper		**	6.3B	6.3B		
Iron		**	781NE	781J	qualify	1,2
Lead		**	2.4BN	2.4BJ	qualify	2
Magnesium		**	656000E	656000J	qualify	1
Manganese		**	152E	152J	qualify	1
Potassium		**	167000E	167000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	4730000E	4730000J	qualify	1
Thallium		**	10.1	10.1		
Zinc		**	33.0*	33.0J	qualify	8
<u>Metals (filtered) ug/l</u>						
Aluminum		**	38.6B	38.6B		
Arsenic		**	51.2N	51.2		
Barium		**	42.3NE	42.3		
Calcium		**	173000	173000		
Copper		**	4.4B	4.4B		
Iron		**	184NE	184		
Magnesium		**	572000E	572000J	qualify	1
Manganese		**	130E	130J	qualify	1
Potassium		**	151000E	152000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	4470000E	4470000J	qualify	1
Thallium		**	11.3	11.3		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	14700			
Cyanide-Free		0.010U	0.026			
Cyanide-Total		0.010U	0.142			
Sulfate		10U	954			
TDS		1.0U	18900			
<b>SW-2</b>						
<u>Volatile Organic Fraction ug/l</u>						
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	163	163		
Antimony		**	39.2N	39.2J	qualify	4
Barium		**	22.0NE	22.0J	qualify	2

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Beryllium		**	0.065B	0.065B		
Calcium		**	204000	204000		
Copper		**	4.5B	4.5B		
Iron		**	430NE	430J	qualify	2
Magnesium		**	717000E	717000J	qualify	1
Manganese		**	102E	102J	qualify	1
Potassium		**	183000E	183000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	5220000E	5220000J	qualify	1
Thallium		**	14.3	14.3		
Zinc		**	119*	119J	qualify	8
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	18.3B	18.3B		
Barium		**	20.9NE	20.9		
Calcium		**	199000	199000		
Copper		**	12.4	12.4		
Iron		**	138NE	138		
Magnesium		**	712000E	712000J	qualify	1
Manganese		**	93.5E	93.5J	qualify	1
Potassium		**	184000E	184000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	5360000E	5360000J	qualify	1
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	15200			
Cyanide-Total		0.010	0.127			
Sulfate		10U	1020			
TDS		1.0U	21300			
<b>SW-3</b>						
<u>Volatile Organic Fraction ug/l</u>						
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	84.9B	84.9B		
Antimony		**	10.7U	---	reject	6
Barium		**	16.5NE	16.5J	qualify	2
Calcium		**	184000	184000		
Copper		**	2.6B	2.6B		
Iron		**	288NE	288J	qualify	2
Magnesium		**	636000	636000J	qualify	1
Manganese		**	78.8E	78.8J	qualify	1
Potassium		**	164000E	164000	qualify	1

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Selenium		**	27.4U	---	reject	6
Sodium		**	4660000E	4660000J	qualify	1
Zinc		**	1.8U	1.8UJ	qualify	8
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	37.6B	37.6B		
Arsenic		**	27.2N	27.2		
Barium		**	17.2NE	17.2		
Calcium		**	193000	193000		
Copper		**	1.9B	1.9B		
Iron		**	258NE	258		
Magnesium		**	714000E	714000J	qualify	1
Manganese		**	83.1E	83.1J	qualify	1
Potassium		**	186000E	186000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	5200000E	5200000J	qualify	1
Thallium		**	9.9B	9.9B		
Zinc		**	9.8B*	9.8B		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	27200			
Sulfate		10U	1020			
TDS		1.0U	21600			
<b>SW-BD (duplicate of SW-2)</b>						
<u>Volatile Organic Fraction ug/l</u>						
<u>Metals (total) Fraction ug/l</u>						
Aluminum		**	143	143		
Antimony		**	25.6N	25.6J	qualify	4
Barium		**	22.3NE	22.3J	qualify	2
Calcium		**	202000	202000		
Copper		**	3.7B	3.7B		
Iron		**	410NE	410J	qualify	2
Magnesium		**	721000E	721000J	qualify	1
Manganese		**	95.0E	95.0J	qualify	1
Potassium		**	190000E	190000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	5240000E	5240000J	qualify	1
Thallium		**	11.9	11.9		
Zinc		**	1.8U	1.8UJ	qualify	8
<u>Metals (filtered) Fraction ug/l</u>						
Aluminum		**	18.5B	18.5B		

Sample	Analyte*	Method Blank Conc.	Lab Report Conc.	QA Report Conc.	Reviewer Decision	Footnote
Barium		**	19.8NE	19.8		
Calcium		**	189000	189000		
Iron		**	155NE	155		
Magnesium		**	683000E	683000J	qualify	1
Manganese		**	91.6E	91.6J	qualify	1
Potassium		**	175000E	175000J	qualify	1
Selenium		**	27.4U	---	reject	6
Sodium		**	4910000E	4910000J	qualify	1
Zinc		**	28.0*	28.0		
<u>Inorganic Fraction mg/l</u>						
Chloride		3.0U	13200			
Cyanide-Total		0.010U	0.173			
Sulfate		10U	1700			
TDS		1.0U	20800			

- \* Only those analytes that were detected or which require qualification are listed. Please refer to the analytical data for further information.
- \*\* No inorganic preparation logs or analytical sequence information provided in the data package. An association of blanks with individual samples is not possible.

## Target and Nontarget Analyte Summary Footnotes

1. The reported metal value was qualified because the Serial Dilution was not within ten percent of sample concentration.
2. The reported metal value was qualified because the spike recovery was between 30 and 74 percent.
3. The reported metal value was qualified because the spike recovery was greater than 125 percent but  $\leq$  200 percent.
4. The reported metal value was qualified because the spike recovery was less than 30%. The reported value actually indicated the minimum concentration at which the metal was present.
5. The non-detected metal value was qualified (UJ) because the spike recovery was between 30 and 74 percent. The possibility is a false negative exists.
6. The non-detected metal value was rejected because the spike recovery was less than 30%.
7. The reported metal value was rejected because the spike recovery was greater than 200%.
8. In the duplicate sample analysis for metals, the analyte fell outside the control limits of  $\pm 20$  percent or  $\pm$  CRDL. Therefore, the results for the metal were qualified.

**INORGANIC DATA VALIDATION REPORT FORMS**

## Data Deliverable Requirements - Inorganics

Site Name: American Cyanamid -  
Bound Brook Facility  
Reviewer: Laurie Johnston  
Analysis for: TAL

Laboratory: IEA - Whippany, NJ

Date of Review: 5/10/94  
Methodology: EPA 200 series

A. Permanently Bound ☒ Yes ☐ No  
B. Paginated ☒ Yes ☐ No  
C. Title Page ☒ Yes ☐ No  
D. Table of Contents Yes ☒ No  
E. Chain of Custody ☒ Yes ☐ No  
F. Laboratory Chronicle ☒ Yes ☐ No  
G. Methodology Review Yes ☒ No

H. Digestion Log Yes ☒ No  
I. Uninitialed Strikeout Yes ☒ No  
J. Legible Copy ☒ Yes ☐ No  
K. Consistent Dates ☒ Yes ☐ No  
L. Preparation Log Yes ☒ No  
M. Analysis Run Log Yes ☒ No

Description of deviations from requirements:

*A "reduced deliverables" reporting package was provided. This reporting format includes summary forms with limited supporting documentation.*

Holding Times for Inorganics  
Page 1 of 2

Circle One: Laboratory or Field ID	Date of sample receipt	ICP Analysis Date	Furnace Analysis Date	Holding Time Exceeded
CRT-3S	7/15/94			
CRT-3D	7/15/94			
FB71394	7/15/94			
CRT-4S	7/15/94			
CRT-4D	7/15/94			
CRT-5S	7/15/94			
CRT-5D	7/15/94			
CRT-2S	7/15/94			
CRT-2D	7/15/94			
CRT-1D	7/15/94			
CRT-1S	7/15/94			
BD71494	7/15/94			
CRT-7D	7/15/94			
CRT-7S	7/15/94			
CRT-6S	7/15/94			
CRT-6D	7/15/94			
CRT-8D	7/15/94			
CRT-8S	7/15/94			
FB71494	7/15/94			
SW-1	7/15/94			
SW-2	7/15/94			
SW-BD	7/15/94			
SW-3	7/15/94			
FB71594	7/15/94			

List of samples that exceeded the holding time, the number of days exceeded by and QA decision:

*The dates of ICP and furnace analyses were not included in the data package.*



Holding Times for Inorganics  
Page 2 of 2

Circle One: Laboratory or Field ID	Date of sample receipt	Flame Analysis Date	Cyanide Analysis Date	Mercury Analysis Date	Holding Time Exceeded
CRT-3S	7/15/94		7/27/94		
CRT-3D	7/15/94		7/27/94		
FB71394	7/15/94		7/27/94		
CRT-4S	7/15/94		7/27/94		
CRT-4D	7/15/94		7/27/94		
CRT-5S	7/15/94		7/27/94		
CRT-5D	7/15/94		7/27/94		
CRT-2S	7/15/94		7/27/94		
CRT-2D	7/15/94		7/27/94		
CRT-1D	7/15/94		7/27/94		
CRT-1S	7/15/94		7/27/94		
BD71494	7/15/94		7/27/94		
CRT-7D	7/15/94		7/27/94		
CRT-7S	7/15/94		7/27/94		
CRT-6S	7/15/94		7/27/94		
CRT-6D	7/15/94		7/27/94		
CRT-8D	7/15/94		7/27/94		
CRT-8S	7/15/94		7/27/94		
FB71494	7/15/94		7/27/94		
SW-1	7/15/94		7/27/94		
SW-2	7/15/94		7/27/94		
SW-BD	7/15/94		7/27/94		
SW-3	7/15/94		7/27/94		
FB71594	7/15/94		7/27/94		

List of samples that exceeded the holding time, the number of days exceeded by and QA decision:

*The dates of mercury and flame analyses were not included in the data package. All cyanide analyses were performed within specified holding times.*

# Instrument Calibration and Initial Calibration Verification (ICV)

Page 1 of 2

Associated Samples:

*Unknown*

1. a. Was the ICP instrument properly standardized? Yes No  
*No raw data or analytical sequence provided, no assessment of standardization can be made.*
- b. Was the GFAA instrument properly standardized? Yes No  
*No raw data or analytical sequence provided, no assessment of standardization can be made.*  
  
If no, were the required standards analyzed immediately after the instrument calibration and were the results within 95-105% recovery? Yes No  
*No raw data or analytical sequence provided, no assessment of standardization can be made.*
- c. Were the instruments used for the analysis of cyanide and mercury properly standardized? Yes No  
*No raw data or analytical sequence provided, no assessment of standardization can be made.*
2. Was an ICV analyzed immediately after the systems were calibrated? Yes No  
*No raw data or analytical sequence provided, no assessment of standardization can be made.*
3. Was the ICV analyzed for every analyte ☒ Yes No
4. Do all ICV analytes meet the QC requirements for percent recovery? Yes ☒ No

Instrument Calibration and Initial Calibration Verification (ICV)

Page 2 of 2

5. a. Show a calculation for the % recovery of one ICV analyte analyzed by ICP  
Analyte: Lab value:

*No raw data provided, no calculations can be made.*

- b. Show a calculation for the % recovery of one ICV analyte analyzed by furnace  
Analyte: Lab value:

*No raw data provided, no calculations can be made.*

- c. Show a calculation for the ICV % recovery of mercury  
Lab value:

*No raw data provided, no calculations can be made.*

- d. Show a calculation for the ICV % recovery of cyanide  
Lab value:

*No raw data provided, no calculations can be made.*

6. Specific comments:

## Continuing Calibration Verification (CCV)

Page 1 of 2

Associated Samples:

*Unknown*

1. a. Was the CCV performed every two (2) hours or at the 10% frequency?

Yes No

*No raw data or analytical sequence provided, no assessment of frequency can be made.*

- b. Was the CCV performed at the beginning and end of sample analysis?

Yes No

*No raw data or analytical sequence provided, no assessment can be made.*

2. Were the CCV standards analyzed for all analytes?

☒ Yes No

3. Was the same concentration used for CCV throughout the analyses?

☒ Yes No

4. Do all CCV analytes meet the QC % recovery?

Yes ☒ No

*Recoveries for several CCVs and analytes were outside specified limits. No analytical sequence information was provided; therefore, no determination of the effect on the samples could be made.*

5. Was the difference in time between the analyses of the CCV and its blank less than or equal to the time between two sample analyses?

Yes No

*No raw data or analytical sequence provided, no assessment can be made.*

## Continuing Calibration Verification (CCV)

Page 2 of 2

6. a. Show a calculation for the % recovery of one CCV analyte analyzed by ICP  
Analyte: \_\_\_\_\_ Lab value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

- b. Show a calculation for the % recovery of one CCV analyte analyzed by furnace  
Analyte: \_\_\_\_\_ Lab value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

- c. Show a calculation for the CCV % recovery of mercury  
Lab value:

*No raw data provided, no calculations can be made.*

- d. Show a calculation for the CCV % recovery of cyanide  
Lab value:

*No raw data provided, no calculations can be made.*

6. Specific comments:

## Contract Required Detection Limit (CRDL)

### Associated Samples:

*No CRDL standard results were provided in the data package. Since the analysis of a CRDL standard is not required under the EPA 200-series methods, no data was qualified based on the lack of a CRDL standard.*

1. Did the required ICP analytes meet QC requirements for % recovery in the analysis of the CRDL standards? Yes No
2. Did the laboratory perform the CRDL analysis for ICP at the correct frequency and concentration? Yes No
3. Show a calculation for the % recovery for the CRDL analysis of one analyte analyzed by ICP  
Analyte: Lab value:
4. Did the AA analytes meet QC requirements for % recovery in the analysis of the CRDL standards? Yes No
5. Show a calculation for the % recovery for the CRDL analysis of one analyte analyzed by AA  
Analyte: Lab value:
6. Specific Comments:  
*No information regarding CRDL standards was provided in the reduced data package.*

## Initial and Continuing Calibration Blank (ICB and CCB)

### Associated Samples:

#### *Unknown*

1. Were the initial calibration blanks analyzed for all analytes and run after the initial calibration verification?

Yes No

*No raw data or analytical sequence provided, no assessment of frequency can be made.*

2. Was the absolute value for all analytes in the initial calibration blank below the CRDL?

☒ Yes No

3. Were the continuing calibration blanks analyzed for all analytes and run after the continuing calibration verification?

Yes No

*No raw data or analytical sequence provided, no assessment of frequency can be made.*

4. Was the frequency for the continuing calibration blanks correct?

Yes No

*No raw data or analytical sequence provided, no assessment of frequency can be made.*

5. Was the absolute value of all analytes for the continuing calibration blank below the CRDL?

☒ Yes No

**Preparation Blank Summary**  
**Page 1 of 3**

Associated Sample Matrix: Groundwater  
Preparation Blank ID: #1  
Units: ug/l

Associated Samples:

*No preparation logs were provided therefore no determination of sample association can be made*

Did the frequency of the preparation blank analysis  
meet method requirements?

Yes    No

Analyte	Conc.	≤CRDL	≥IDL	Comments/Action
<i>Aluminum</i>	<i>27.04</i>	<i>yes</i>	<i>yes</i>	
<i>Arsenic</i>	<i>2.42</i>	<i>yes</i>	<i>yes</i>	
<i>Iron</i>	<i>27.11</i>	<i>yes</i>	<i>yes</i>	
<i>Lead</i>	<i>1.70</i>	<i>yes</i>	<i>yes</i>	
<i>Zinc</i>	<i>13.02</i>	<i>yes</i>	<i>yes</i>	



**Preparation Blank Summary**  
**Page 2 of 3**

Associated Sample Matrix: Groundwater  
 Preparation Blank ID: #2  
 Units: ug/l

Associated Samples:

*No preparation logs were provided therefore no determination of sample association can be made*

Did the frequency of the preparation blank analysis  
 meet method requirements?

Yes    No

Analyte	Conc.	≤CRDL	≥IDL	Comments/Action
<i>Antimony</i>	<i>3.96</i>	<i>yes</i>	<i>yes</i>	
<i>Barium</i>	<i>2.88</i>	<i>yes</i>	<i>yes</i>	
<i>Beryllium</i>	<i>0.32</i>	<i>yes</i>	<i>yes</i>	
<i>Calcium</i>	<i>51.01</i>	<i>yes</i>	<i>yes</i>	
<i>Chromium</i>	<i>2.74</i>	<i>yes</i>	<i>yes</i>	
<i>Iron</i>	<i>19.88</i>	<i>yes</i>	<i>yes</i>	
<i>Lead</i>	<i>1.05</i>	<i>yes</i>	<i>yes</i>	
<i>Magnesium</i>	<i>40.66</i>	<i>yes</i>	<i>yes</i>	
<i>Manganese</i>	<i>8.5</i>	<i>yes</i>	<i>yes</i>	
<i>Zinc</i>	<i>13.08</i>	<i>yes</i>	<i>yes</i>	

**Preparation Blank Summary**  
**Page 3 of 3**

Associated Sample Matrix: Groundwater  
Preparation Blank ID: #3  
Units: ug/l

Associated Samples:

*No preparation logs were provided therefore no determination of sample association can be made*

Did the frequency of the preparation blank analysis  
meet method requirements?

Yes    No

Analyte	Conc.	≤CRDL	≥IDL	Comments/Action
<i>Calcium</i>	<i>41.94</i>	<i>yes</i>	<i>yes</i>	
<i>Chromium</i>	<i>2.43</i>	<i>yes</i>	<i>yes</i>	
<i>Iron</i>	<i>23.53</i>	<i>yes</i>	<i>yes</i>	
<i>Manganese</i>	<i>0.50</i>	<i>yes</i>	<i>yes</i>	
<i>Nickel</i>	<i>32.94</i>	<i>yes</i>	<i>yes</i>	
<i>Sodium</i>	<i>89.35</i>	<i>yes</i>	<i>yes</i>	
<i>Zinc</i>	<i>13.17</i>	<i>yes</i>	<i>yes</i>	

## ICP Interference Check Sample

Associated Samples:

*All samples*

1. Was an ICP interference check sample performed at the correct frequency?

Yes No

*No raw data or analytical sequence provided, no assessment of frequency can be made.*

2. a. Were the interferents for solution A reported?

☒ Yes No

- b. Were the analytes and interferents for solution B reported?

☒ Yes No

3. Were the concentrations of Al, Ca, Fe, and Mg in the associated samples found to be significantly less than (i.e.,  $\leq 50\%$ ) their respective concentrations in solution A?

Yes ☒ No

4. Did all required analytes in solution AB meet the QC limit of 80-120%?

Yes ☒ No

5. Show the calculation for % recovery for one analyte in solution AB  
Analyte: \_\_\_\_\_ Lab Value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

6. Specific Comments

## Sample Spike Analysis

Page 1 of 8

Sample spiked: CRT-3D

Matrix: groundwater

Units: ug/l

% Solids: NA

### Associated Samples:

CRT-6S, CRT-3S, CRT-5S, FB71494, CRT-1S, CRT-3D, CRT-4S, CRT-4D, CRT-5D, CRT-2S, CRT-2D, CRT-1D, FB71394, CRT-1S, BD71494, CRT-7D, CRT-7S, CRT-6D, CRT-8D, CRT-8S

1. Was the sample spike analysis performed at the correct frequency ☒ Yes ☐ No
2. Was the sample spike analysis performed on a field sample? ☒ Yes ☐ No
3. a. Were two analytical methods used to obtain values for one analyte? Yes ☒ No  
b. Was sample spike analysis performed using both method for that analyte? Yes ☐ No ☒ NA
4. Was sample spike analysis performed at the proper concentration? ☒ Yes ☐ No

Sample Spike Analysis  
Page 2 of 8

5. Did the % recovery for all analytes whose sample result was less than four times the spike added (SA) meet the 75-125% criteria?

Yes

☒ No

Aluminum	241.1%
Arsenic	53.5%
Barium	65.1%
Beryllium	71.8%
Mercury	134.0%
Potassium	47.0%
Selenium	0.0%
Thallium	66.0%
Vanadium	73.1%

6. Were outliers correctly flagged the "N" qualifier?

☒ Yes

No

7. a. Show calculation for % recovery for one analyte analyzed by ICP  
Analyte: \_\_\_\_\_ Lab Value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

- b. Show calculation for % recovery for one analyte analyzed by AA  
Analyte: \_\_\_\_\_ Lab Value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

- c. Show calculation for % recovery for mercury  
Lab Value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

- d. Show calculation for % recovery for cyanide  
Lab Value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

Sample Spike Analysis  
Page 3 of 8

Sample spiked: CRT-3D filtered  
Matrix: groundwater  
Units: ug/l  
% Solids: NA

Associated Samples:

*CRT-6SF, CRT-3SF, CRT-5SF, FB71494F, CRT-1SF, CRT-3DF, CRT-4SF, CRT-4DF, CRT-5DF, CRT-2SF, CRT-2DF, CRT-1DF, FB71394F, CRT-1SF, BD71494F, CRT-7DF, CRT-7SF, CRT-6DF, CRT-8DF, CRT-8SF*

1. Was the sample spike analysis performed at the correct frequency ☒ Yes    No
2. Was the sample spike analysis performed on a field sample? ☒ Yes    No
3. a. Were two analytical methods used to obtain values for one analyte? Yes    ☒ No  
b. Was sample spike analysis performed using both method for that analyte? Yes    No    ☒ NA
4. Was sample spike analysis performed at the proper concentration? ☒ Yes    No

# Sample Spike Analysis

Page 4 of 8

5. Did the % recovery for all analytes whose sample result was less than four times the spike added (SA) meet the 75-125% criteria?

Yes

☒ No

Antimony	179.2%
Arsenic	0.0%
Barium	68.0%
Beryllium	74.4%
Potassium	71.9%
Selenium	0.0%
Thallium	30.6%

6. Were outliers correctly flagged the "N" qualifier?

☒ Yes

No

7. a. Show calculation for % recovery for one analyte analyzed by ICP  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

- b. Show calculation for % recovery for one analyte analyzed by AA  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

- c. Show calculation for % recovery for mercury  
Lab Value:

*No raw data provided, no calculations can be made.*

- d. Show calculation for % recovery for cyanide  
Lab Value:

*No raw data provided, no calculations can be made.*

Sample Spike Analysis  
Page 5 of 8

Sample spiked: SW-1  
Matrix: surface water  
Units: ug/l  
% Solids: NA

Associated Samples:

*FB71594, SW-2, SW-BD, SW-3, SW-1*

- |    |  |                                      |  |
|----|--|--------------------------------------|--|
| 1. | Was the sample spike analysis performed at the correct frequency           | <input checked="" type="radio"/> Yes | <input type="radio"/> No                                     |
| 2. | Was the sample spike analysis performed on a field sample?                 | <input checked="" type="radio"/> Yes | <input type="radio"/> No                                     |
| 3. | a. Were two analytical methods used to obtain values for one analyte?      | <input type="radio"/> Yes            | <input checked="" type="radio"/> No                          |
|    | b. Was sample spike analysis performed using both method for that analyte? | <input type="radio"/> Yes            | <input type="radio"/> No <input checked="" type="radio"/> NA |
| 4. | Was sample spike analysis performed at the proper concentration?           | <input checked="" type="radio"/> Yes | <input type="radio"/> No                                     |



Sample Spike Analysis  
Page 6 of 8

5. Did the % recovery for all analytes whose sample result was less than four times the spike added (SA) meet the 75-125% criteria?

Yes

☒ No

<b>Antimony</b>	<b>-11.2%</b>
<b>Arsenic</b>	<b>182.0%</b>
<b>Barium</b>	<b>68.4%</b>
<b>Iron</b>	<b>69.0%</b>
<b>Lead</b>	<b>66.0%</b>
<b>Selenium</b>	<b>0.0%</b>

6. Were outliers correctly flagged the "N" qualifier?

☒ Yes

No

7. a. Show calculation for % recovery for one analyte analyzed by ICP  
Analyte: \_\_\_\_\_ Lab Value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

- b. Show calculation for % recovery for one analyte analyzed by AA  
Analyte: \_\_\_\_\_ Lab Value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

- c. Show calculation for % recovery for mercury  
Lab Value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

- d. Show calculation for % recovery for cyanide  
Lab Value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

Sample Spike Analysis  
Page 7 of 8

Sample spiked: SW-1 filtered  
Matrix: groundwater  
Units: ug/l  
% Solids: NA

Associated Samples:

*FB71594F, SW-2F, SW-BDF, SW-3F, SW-1F*

- |    |  |                                      |                                     |
|----|--|--------------------------------------|-------------------------------------|
| 1. | Was the sample spike analysis performed at the correct frequency           | <input checked="" type="radio"/> Yes | <input type="radio"/> No            |
| 2. | Was the sample spike analysis performed on a field sample?                 | <input checked="" type="radio"/> Yes | <input type="radio"/> No            |
| 3. | a. Were two analytical methods used to obtain values for one analyte?      | <input type="radio"/> Yes            | <input checked="" type="radio"/> No |
|    | b. Was sample spike analysis performed using both method for that analyte? | <input type="radio"/> Yes            | <input type="radio"/> No            |
| 4. | Was sample spike analysis performed at the proper concentration?           | <input checked="" type="radio"/> Yes | <input type="radio"/> No            |

☒ UA

Sample Spike Analysis  
Page 8 of 8

5. Did the % recovery for all analytes whose sample result was less than four times the spike added (SA) meet the 75-125% criteria? Yes    No

*Recovery data provided for mercury only.*

6. Were outliers correctly flagged the "N" qualifier? Yes    No

7. a. Show calculation for % recovery for one analyte analyzed by ICP  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

- b. Show calculation for % recovery for one analyte analyzed by AA  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

- c. Show calculation for % recovery for mercury  
Lab Value:

*No raw data provided, no calculations can be made.*

- d. Show calculation for % recovery for cyanide  
Lab Value:

*No raw data provided, no calculations can be made.*

Post-Digestion Spike Analysis Form

Page 1 of 3

Sample Spiked: CRT-3D

Matrix: groundwater

Units: ug/l

% Solids: NA

Associated Samples:

CRT-6S, CRT-3S, CRT-5S, FB71494, CRT-1S, CRT-3D, CRT-4S, CRT-4D, CRT-5D, CRT-2S, CRT-2D, CRT-1D, FB71394, CRT-1S, BD71494, CRT-7D, CRT-7S, CRT-6D, CRT-8D, CRT-8S

1. Was post-digestion spike analysis performed on all applicable analytes whose sample spike results did not meet QC requirements?

Yes

☒ No

*No post-digestion spike performed for potassium*

2. Was post-digestion spike performed at the proper concentration?

☒ Yes

No

3. List the analytes and their % recovery where post-digestion spike analysis was performed but still did not meet the QC criteria

Barium	70.6%
Beryllium	70.8%
Vanadium	68.2%

4. Show the calculation for % recovery for at least one analyte where post-digestion spike analysis was performed

Analyte:

Lab Value:

*No raw data provided, no calculations can be made.*

5. Comments:

Post-Digestion Spike Analysis Form  
Page 2 of 3

Sample Spiked: CRT-3D filtered  
Matrix: groundwater  
Units: ug/l  
% Solids: NA

Associated Samples:

CRT-6SF, CRT-3SF, CRT-5SF, FB71494F, CRT-1SF, CRT-3DF, CRT-4SF, CRT-4DF, CRT-5DF, CRT-2SF, CRT-2DF, CRT-1DF, FB71394F, CRT-1SF, BD71494F, CRT-7DF, CRT-7SF, CRT-6DF, CRT-8DF, CRT-8SF

1. Was post-digestion spike analysis performed on all applicable analytes whose sample spike results did not meet QC requirements?

Yes

☒ No

*No post-digestion spike performed for potassium*

2. Was post-digestion spike performed at the proper concentration?

☒ Yes

No

3. List the analytes and their % recovery where post-digestion spike analysis was performed but still did not meet the QC criteria

Barium	65.3%
Beryllium	73.7%

4. Show the calculation for % recovery for at least one analyte where post-digestion spike analysis was performed

Analyte:

Lab Value:

*No raw data provided, no calculations can be made.*

5. Comments:

Sample Spiked: SW-1  
Matrix: surface water  
Units: ug/l  
% Solids: NA

FB71594, SW-2, SW-BD, SW-3, SW-1

- No raw data provided, no calculations can be made.*

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Duplicate Analysis  
Page 1 of 8

Duplicate Sample: CRT-3D

Matrix: groundwater

Units: ug/l

% Solids: NA

Associated Samples:

*CRT-6S, CRT-3S, CRT-5S, FB71494, CRT-1S, CRT-3D, CRT-4S, CRT-4D, CRT-5D, CRT-2S, CRT-2D, CRT-1D, FB71394, CRT-1S, BD71494, CRT-7D, CRT-7S, CRT-6D, CRT-8D, CRT-8S*

- |    |   |                                      |  |
|----|---|--------------------------------------|--|
| 1. | Were duplicate analyses performed at the correct frequency?   | <input checked="" type="radio"/> Yes | <input type="radio"/> No                                     |
| 2. | Was duplicate analysis performed on a field sample?   | <input checked="" type="radio"/> Yes | <input type="radio"/> No                                     |
| 3. | a. Were two analytical methods used to obtain values for one analyte?                                   | <input type="radio"/> Yes            | <input checked="" type="radio"/> No                          |
|    | b. Was duplicate analysis performed using both method for that analyte?                                 | <input type="radio"/> Yes            | <input type="radio"/> No <input checked="" type="radio"/> NA |
| 4. | Did the laboratory use the correct control limits (i.e., $\pm$ CRDL or 20%) to judge duplicate results? | <input checked="" type="radio"/> Yes | <input type="radio"/> No                                     |
| 5. | Do all analytes meet these control limits?  | <input type="radio"/> Yes            | <input checked="" type="radio"/> No                          |

Duplicate Analysis  
Page 2 of 8

6. Were outliers correctly flagged with the "\*" qualifier? Yes No

7. a. Show calculation for RPD for one analyte analyzed by ICP  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

b. Show calculation for RPD for one analyte analyzed by AA  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

c. Show calculation for RPD for mercury  
Lab Value:

*No raw data provided, no calculations can be made.*

d. Show calculation for RPD for cyanide  
Lab Value:

*No raw data provided, no calculations can be made.*

8. Comments



**Duplicate Analysis**  
**Page 3 of 8**

Duplicate Sample: CRT-3D filtered  
Matrix: groundwater  
Units: ug/l  
% Solids: NA

**Associated Samples:**

*CRT-6SF, CRT-3SF, CRT-5SF, FB71494F, CRT-1SF, CRT-3DF, CRT-4SF, CRT-4DF, CRT-5DF, CRT-2SF, CRT-2DF, CRT-1DF, FB71394F, CRT-1SF, BD71494F, CRT-7DF, CRT-7SF, CRT-6DF, CRT-8DF, CRT-8SF*

1. Were duplicate analyses performed at the correct frequency? ☒ Yes ☐ No
2. Was duplicate analysis performed on a field sample? ☒ Yes ☐ No
3. a. Were two analytical methods used to obtain values for one analyte? Yes ☐ No ☒  
b. Was duplicate analysis performed using both method for that analyte? Yes ☐ No ☒
4. Did the laboratory use the correct control limits (i.e.,  $\pm$  CRDL or 20%) to judge duplicate results? ☒ Yes ☐ No
5. Do all analytes meet these control limits? Yes ☐ No ☒

*Lead >CRDL*

Duplicate Analysis  
Page 4 of 8

6. Were outliers correctly flagged with the "\*" qualifier? Yes No

7. a. Show calculation for RPD for one analyte analyzed by ICP  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

b. Show calculation for RPD for one analyte analyzed by AA  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

c. Show calculation for RPD for mercury  
Lab Value:

*No raw data provided, no calculations can be made.*

d. Show calculation for RPD for cyanide  
Lab Value:

*No raw data provided, no calculations can be made.*

8. Comments

**Duplicate Analysis**  
**Page 5 of 8**

Duplicate Sample: SW-1  
Matrix: surface water  
Units: ug/l  
% Solids: NA

**Associated Samples:**

*FB71594, SW-2, SW-BD, SW-3, SW-1*

- |    |   |                                      |  |
|----|---|--------------------------------------|--|
| 1. | Were duplicate analyses performed at the correct frequency?   | <input checked="" type="radio"/> Yes | <input type="radio"/> No                                     |
| 2. | Was duplicate analysis performed on a field sample?   | <input checked="" type="radio"/> Yes | <input checked="" type="radio"/> No                          |
| 3. | a. Were two analytical methods used to obtain values for one analyte?                                   | <input type="radio"/> Yes            | <input checked="" type="radio"/> No                          |
|    | b. Was duplicate analysis performed using both method for that analyte?                                 | <input type="radio"/> Yes            | <input type="radio"/> No <input checked="" type="radio"/> NA |
| 4. | Did the laboratory use the correct control limits (i.e., $\pm$ CRDL or 20%) to judge duplicate results? | <input checked="" type="radio"/> Yes | <input type="radio"/> No                                     |
| 5. | Do all analytes meet these control limits?  | <input type="radio"/> Yes            | <input checked="" type="radio"/> No                          |
- Zinc*                      *>CRDL*

Duplicate Analysis  
Page 6 of 8

6. Were outliers correctly flagged with the "\*" qualifier? Yes No

7. a. Show calculation for RPD for one analyte analyzed by ICP  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

b. Show calculation for RPD for one analyte analyzed by AA  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

c. Show calculation for RPD for mercury  
Lab Value:

*No raw data provided, no calculations can be made.*

d. Show calculation for RPD for cyanide  
Lab Value:

*No raw data provided, no calculations can be made.*

8. Comments

## Duplicate Analysis

Page 7 of 8

Duplicate Sample: SW-1 filtered

Matrix: surface water

Units: ug/l

% Solids: NA

Associated Samples:

*FB71594F, SW-2F, SW-BDF, SW-3F, SW-1F*

- |    |   |                                      |   |
|----|---|--------------------------------------|---|
| 1. | Were duplicate analyses performed at the correct frequency?   | <input checked="" type="radio"/> Yes | No  |
| 2. | Was duplicate analysis performed on a field sample?   | <input checked="" type="radio"/> Yes | No  |
| 3. | a. Were two analytical methods used to obtain values for one analyte?                                   | Yes                                  | <input checked="" type="radio"/> No                                     |
|    | b. Was duplicate analysis performed using both method for that analyte?                                 | Yes                                  | <input checked="" type="radio"/> No <input checked="" type="radio"/> NA |
| 4. | Did the laboratory use the correct control limits (i.e., $\pm$ CRDL or 20%) to judge duplicate results? | <input checked="" type="radio"/> Yes | No  |
| 5. | Do all analytes meet these control limits?  | Yes                                  | No  |

*Results reported for mercury only*

**Duplicate Analysis**  
**Page 8 of 8**

6. Were outliers correctly flagged with the "\*" qualifier? Yes No

7. a. Show calculation for RPD for one analyte analyzed by ICP  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

b. Show calculation for RPD for one analyte analyzed by AA  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

c. Show calculation for RPD for mercury  
Lab Value:

*No raw data provided, no calculations can be made.*

d. Show calculation for RPD for cyanide  
Lab Value:

*No raw data provided, no calculations can be made.*

8. Comments

## Laboratory Control Sample

Matrix: water

Units: ug/l

Associated Samples:

*Unknown*

1. Was the laboratory control sample performed at the correct frequency? Yes    No
2. Do all analytes meet the QC limits of 80-120% (except silver, antimony, mercury, and cyanide) or within the control limits established by EPA for soils? ☒ Yes    No
3. a. Show calculation for at least one analyte analyzed by ICP  
Analyte: Lab Value:  
Soil limits:

*No raw data provided, no calculations can be made.*

- b. Show calculation for at least one analyte analyzed by furnace GFAA  
Analyte: Lab Value:  
Soil limits:

*No raw data provided, no calculations can be made.*

ICP Serial Dilution  
Page 1 of 3

Diluted Sample:  
Matrix: groundwater  
Units: ug/l  
% Solids: NA

Associated Samples:

*CRT-6S, CRT-3S, CRT-5S, FB71494, CRT-1S, CRT-3D, CRT-4S, CRT-4D, CRT-5D, CRT-2S, CRT-2D, CRT-1D, FB71394, CRT-1S, BD71494, CRT-7D, CRT-7S, CRT-6D, CRT-8D, CRT-8S*

1. Was a serial dilution performed at the correct frequency? ☒ Yes No
2. Was a field sample used for serial dilution? ☒ Yes No
3. Was a serial dilution performed for all analytes greater than fifty times the IDL? ☒ Yes No
4. For all analytes greater than fifty times the IDL, did the serial dilution analysis meet the QC limit requirement of 10% D? Yes ☒ No

<i>Barium</i>	<i>24.3</i>
<i>Iron</i>	<i>19.5</i>
<i>Manganese</i>	<i>15.8</i>
<i>Potassium</i>	<i>10.1</i>
<i>Sodium</i>	<i>21.5</i>

5. Were the outliers flagged with the "E" qualifier? ☒ Yes No
6. Show calculation for %D for one analyte analyzed by ICP  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*



ICP Serial Dilution  
Page 2 of 3

Diluted Sample:  
Matrix: groundwater - filtered  
Units: ug/l  
% Solids: NA

Associated Samples:

*CRT-6SF, CRT-3SF, CRT-5SF, FB71494F, CRT-1SF, CRT-3DF, CRT-4SF, CRT-4DF, CRT-5DF, CRT-2SF, CRT-2DF, CRT-1DF, FB71394F, CRT-1SF, BD71494F, CRT-7DF, CRT-7SF, CRT-6DF, CRT-8DF, CRT-8SF*

1. Was a serial dilution performed at the correct frequency? ☒ Yes ☐ No
2. Was a field sample used for serial dilution? ☒ Yes ☐ No
3. Was a serial dilution performed for all analytes greater than fifty times the IDL? ☒ Yes ☐ No
4. For all analytes greater than fifty times the IDL, did the serial dilution analysis meet the QC limit requirement of 10% D? ☐ Yes ☒ No

<i>Barium</i>	<i>39.7</i>
<i>Calcium</i>	<i>23.5</i>
<i>Iron</i>	<i>17.1</i>
<i>Magnesium</i>	<i>22.7</i>
<i>Manganese</i>	<i>15.9</i>
<i>Potassium</i>	<i>12.5</i>

5. Were the outliers flagged with the "E" qualifier? ☒ Yes ☐ No
6. Show calculation for %D for one analyte analyzed by ICP  
Analyte: \_\_\_\_\_ Lab Value: \_\_\_\_\_

*No raw data provided, no calculations can be made.*

ICP Serial Dilution  
Page 3 of 3

Diluted Sample:  
Matrix: surface water  
Units: ug/l  
% Solids: NA

Associated Samples:

*FB71594, SW-2, SW-BD, SW-3, SW-1*

1. Was a serial dilution performed at the correct frequency? ☒ Yes No
2. Was a field sample used for serial dilution? ☒ Yes No
3. Was a serial dilution performed for all analytes greater than fifty times the IDL? ☒ Yes No
4. For all analytes greater than fifty times the IDL, did the serial dilution analysis meet the QC limit requirement of 10% D? Yes ☒ No

<i>Barium</i>	<i>14.2</i>
<i>Iron</i>	<i>27.9</i>
<i>Magnesium</i>	<i>94.8</i>
<i>Manganese</i>	<i>10.8</i>
<i>Potassium</i>	<i>93.7</i>
<i>Sodium</i>	<i>97.3</i>

5. Were the outliers flagged with the "E" qualifier? ☒ Yes No
6. Show calculation for %D for one analyte analyzed by ICP  
Analyte: Lab Value:

*No raw data provided, no calculations can be made.*

Graphite Furnace AA (GFAA)  
Page 1 of 3

Circle Analytes:      As      Pb      Se      TI      Other (specify)

Associated Samples:

1. Were the injections made in duplicate and average values reported? Yes    No  
*No raw data or analytical sequence provided, no assessment can be made.*
2. If the average concentration is  $\geq$  CRDL, was the average value within the  $\pm 20\%$  RSD or CV? Yes    No  
*No raw data provided, no assessment can be made.*
3. Were all sample results within the calibration range? Yes    No  
*No standard information provided, no assessment can be made.*
4. Were all sample results including the laboratory control sample and preparation blank spiked at two times the CRDL to determine if MSA was required? Yes    No  
*No raw data provided, no assessment can be made.*
5. Was the preparation blank spike recovery within the control limits of 85-115%? Yes    No  
*No spike recovery data provided, no assessment can be made.*
6. Was the spike recovery for all samples  $\geq 40\%$ ? Yes    No  
*No spike recovery data provided, no assessment can be made.*

Graphite Furnace AA (GFAA)  
Page 2 of 3

Circle Analytes:      As      Pb      Se      TI      Other (specify)

7. For any sample(s) whose spike recovery was greater than 40% and whose absorbance was less than 50% of the spike absorbance, was the spike recovery within the 85-115% control limit?      Yes      No

*No spike recovery or raw data provided, no assessment can be made.*

8. For any sample(s) whose spike recovery was greater than 40% and whose absorbance was  $\geq 50\%$  of the spike absorbance, was the spike recovery within the 85-115% control limit?      Yes      No

*No spike recovery or raw data provided, no assessment can be made.*

If no, did the laboratory perform MSA analysis      Yes      No

*No analytical sequence, spike recovery, or raw data provided, no assessment can be made.*

If yes, was the MSA data within the calibration range?      Yes      No

*No spike recovery or raw data provided, no assessment can be made.*

Was the correlation coefficient (R)  $\geq 0.995$ ?      Yes      No

*No raw data provided, no assessment can be made.*

If no, was the MSA analysis repeated once?      Yes      No

*No raw data provided, no assessment can be made.*

Was the correlation coefficient  $\geq 0.995$  on the MSA reanalysis?      Yes      No

*No raw data provided, no assessment can be made.*

Circle Analytes:      As      Pb      Se      Tl      Other (specify)

- No raw data provided, no calculations can be made.*

- No raw data provided, no calculations can be made.*

- The inclusion of GFAA raw data, analytical sequence, and analytical spike recoveries is not required under "reduced reporting".

## Verification of Instrument Parameter Reports

1. Was the IDL analyzed and reported quarterly for each analyte on Form XI-IN? Yes No

*Form XI-IN is not required under "reduced reporting"*

2. Was the IDL below the CRDL for each analyte? Yes No

3. Was the ICP interelement correction factor reported for each element on Form XII-IN? Yes No

*Form XII-IN is not required under "reduced reporting"*

4. Was the linear range established quarterly and reported for each element on Form XIII-IN? Yes No

*Form XIII-IN is not required under "reduced reporting"*

5. List the dates for the Verification of Instrument Parameter reports for:

- a. IDL
- b. ICP linear range
- c. ICP interelement correction factors

## Sample Result Verification

### Associated Samples:

*All samples*

1. Were all sample values reported within the calibration range? Yes No

*No calibration information provided, no assessment can be made.*

2. Was the raw data free of anomalies? Yes No

*Reporting of raw data is not required under "reduced reporting".*

3. Was the data package free of computational and transcription errors? Yes No

4. Was % solids analysis performed for all non-aqueous samples? Yes No

5. Show calculation for % solids for one sample  
Sample: Lab Value:

6. Verify that non-aqueous samples were reported on a dry-weight basis by recalculating the result for one analyte in a sample.  
Sample: Lab Value:  
Analyte:

7. If two analytical methods were used to obtain values for the same element, were their results within 20% RPD? Yes No

**ORGANIC DATA VALIDATION REPORT FORMS**



## Data Deliverable Requirements

Site Name: Cytec Industries, Inc. -  
Carteret, New Jersey  
Laboratory: IEA - Whippany, NJ

Lead Division/Bureau:

Fraction	Reviewer	Date of Review
Volatile	Laurie Johnston	1/30/95
Semivolatile		
Pesticide/PCB		

A. Permanently Bound

(Yes)

No J. Legible Copy

(Yes)

No

B. Paginated

(Yes)

No K. Consistent Dates

(Yes)

No

C. Title Page

(Yes)

No L. GC/MS Confirmation

Yes

No

NA

D. Table of Contents

Yes

(No)

M. GC/MS Negatives

Yes

No

NA

E. Chain of Custody

(Yes)

No N. Labeled RICs, TICs

Yes

No

NA

F. Internal Chain of Custody

(Yes)

No O. Labeled Chromatograms

(Yes)

No

G. Methodology Review

Yes

(No)

P. Diskettes Submitted

Yes

No

H. Non-conformance Summary

(Yes)

No Q. SDG File

Yes

No

I. Uninitialed Strikeout

Yes

(No)

Description of deviations from requirements:

*A "reduced deliverables" reporting package was provided. This reporting format includes summary forms with limited supporting documentation.*

## Holding Times

Site Name: American Cyanamid -  
Bound Brook Facility

Fraction: Volatiles

Sample ID	Matrix	VTSR	Extraction Date	DE	Analysis Date	DA*	QA Decision
CRT-3S	A	7/15/94			7/20/94		
CRT-3D	A	7/15/94			7/20/94		
FB71394	A	7/15/94			7/21/94		
CRT-4S	A	7/15/94			7/20/94		
CRT-4D	A	7/15/94			7/20/94		
CRT-5S	A	7/15/94			7/20/94		
CRT-5D	A	7/15/94			7/20/94		
CRT-2S	A	7/15/94			7/20/94		
CRT-2D	A	7/15/94			7/20/94		
CRT-1D	A	7/15/94			7/20/94		
CRT-1S	A	7/15/94			7/20/94		
BD71494	A	7/15/94			7/21/94		
CRT-7D	A	7/15/94			7/21/94		
CRT-7S	A	7/15/94			7/21/94		
CRT-6S	A	7/15/94			7/20/94		
CRT-6D	A	7/15/94			7/21/94		
CRT-8D	A	7/15/94			7/21/94		
CRT-8S	A	7/15/94			7/21/94		
FB71494	A	7/15/94			7/20/94		
TRIP BLANK	A	7/15/94			7/20/94		
SW-1	A	7/15/94			7/22/94		
SW-2	A	7/15/94			7/22/94		
SW-BD	A	7/15/94			7/22/94		
SW-3	A	7/15/94			7/22/94		
FB71594	A	7/15/94			7/22/94		
TB	A	7/15/94			7/22/94		

Notes:

A Aqueous

S Non-aqueous

DE Number of days holding time to extraction was exceeded

DA Number of days holding time to analysis was exceeded

\* *USEPA Method 624 14 day from collection holding time applied*

**GC/MS Instrument Performance Check and Initial Calibration #1**  
**Volatile Organic Fraction**  
**Page 1 of 4**

Site Name: Cytec Industries - Carteret, New Jersey

Associated Samples and Blanks:

*All Samples*

**A. BFB GC/MS Instrument Performance Check (IPC)**

Injection Date: 7/12/94 Injection Time: 08:16 Instrument ID: MSE  
Heated Purge (Y/N): N Column: DB-624 ID: 0.53mm Data File: EC358

1. Is the BFB acceptable?

☒ Yes ☐ No

2. Were all standards, samples, blanks and QC analyzed within 12 hours of the injection of the IPC?

☒ Yes ☐ No

**B. Calibration**

1. List lab file IDs and date(s) of calibration:

Calibration Level*	Lab File ID	Date of Calibration
RRF10	EC7017	7/12/94
RRF30	EC7018	7/12/94
RRF50	EC7019	7/12/94
RRF100	EC7020	7/12/94
RRF200	EC7021	7/12/94

\* Calibration levels used deviate from CLP specifications.

GC/MS Instrument Performance Check and Initial Calibration #1  
Volatile Organic Fraction  
Page 2 of 4

2. Performance Check

- a. Does the initial calibration meet the criteria for the  
23 volatile compounds and the system monitoring compounds?

Yes No

NA

Compound	Minimum RRF		Maximum %RSD	
Bromomethane	0.100		20.5	
Vinyl Chloride	0.100		20.5	
1,1-Dichloroethene	0.100		20.5	
1,1-Dichloroethane	0.200		20.5	
Chloroform	0.200		20.5	
1,2-Dichloroethane	0.100		20.5	
1,1,1-Trichloroethane	0.100		20.5	
Carbon Tetrachloride	0.100		20.5	
Bromodichloromethane	0.200		20.5	
cis-1,3-Dichloropropene	0.200		20.5	
Trichloroethene	0.300		20.5	
Dibromochloromethane	0.100		20.5	
1,1,2-Trichloroethane	0.100		20.5	
Benzene	0.500		20.5	
trans-1,3-Dichloropropene	0.100		20.5	
Bromoform	0.100		20.5	
Tetrachloroethene	0.200		20.5	
1,1,2,2-Tetrachloroethane	0.500		20.5	
Toluene	0.400		20.5	
Chlorobenzene	0.500		20.5	
Ethylbenzene	0.100		20.5	
Styrene	0.300		20.5	
Xylenes (total)	0.300		20.5	
Bromofluorobenzene (SMC)	0.200		20.5	

If no:

1. Circle the compound(s) that are outside the limits and enter their value(s)
2. If three or more analytes do not meet the %RSD and/or RRF criteria noted above, reject the initial calibration and all associated field samples, QC samples, and blanks
3. If any RRF is less than 0.01, reject the initial calibration and all associated field samples, QC samples, and blanks
4. If any %RSD is greater than 40%, reject the initial calibration and all associated field samples, QC samples, and blanks.

**GC/MS Instrument Performance Check and Initial Calibration #1**  
**Volatile Organic Fraction**  
**Page 3 of 4**

- b. Is the minimum RRF criteria of 0.010 met for the 12 compounds for which no %RSD has been established?

Yes No

NA

Compound	RRF	Compound	RRF
Acetone		1,2-Dichloropropane	
2-Butanone		2-Hexanone	
Carbon Disulfide		Methylene Chloride	
Chloroethane		4-Methyl-2-pentanone	
Chloromethane		Toluene-d8	
1,2-Dichloroethene		1,2-Dichloroethane-d4	

If no,

- 1) Qualify the positive results of the non-SMC compounds in the associated samples, blanks and QC
- 2) No action for SMC compounds
- 3) Reject the non-detects for the non-SMC compounds in the samples, blanks, and QC
- 4) Circle the compounds that are outside of limits and enter values

**Comment:**

*Method 624 specifies a maximum RSD of 35% for all compounds. The %RSD for all compounds were within this limit.*

GC/MS Instrument Performance Check and Initial Calibration #1  
Volatile Organic Fraction  
Page 4 of 4

B. Calculations

For all calculations provide compound name, complete calculation, and report the laboratory result and the reviewer result

1. Show calculations for one %RSD

Compound: *Chloromethane*

Lab Value: 4.324

RF10 = 1.74272      RF400 = 1.60652  
RF30 = 1.52812  
RF50 = 1.64448  
RF100 = 1.60614  
RF200 = 1.60686

$$\%RSD = \frac{SD}{\bar{x}} \times 100$$
$$= 4.327$$

2. Show calculation for one RRF

Compound:

Lab Value:

*No integration data included in the data package, RRF cannot be calculated.*

C. Comments

**GC/MS Instrument Performance Check and Continuing Calibration #1**  
**Volatile Organic Fraction**  
**Page 1 of 4**

Site Name: American Cyanamid - Bound Brook Facility

Associated Samples and Blanks:

*CRT-6S, CRT-3S, CRT-5S, FB71494, CRT-1S, TRIP BLANK, CRT-3D, CRT-4S, CRT-4D, CRT-5D, CRT-2S, CRT-2D, CRT-1D*

**A. BFB GC/MS Instrument Performance Check (IPC)**

Injection Date: *7/20/94* Injection Time: *08:59* Instrument ID: *MSE*  
Heated Purge (Y/N): *N* Column: *DB-624* ID: *0.53* Data File: *EC367*

1. Is the BFB acceptable?

☒ Yes ☐ No

2. Were all standards, samples, blanks and QC analyzed within 12 hours of the injection of the IPC?

Yes ☐ ☒ No

*Samples CRT-2D and CRT-1D were injected over the 12 hour criteria. Method 624 specifies that a performance evaluation standard be analyzed daily. No qualification has been added to the samples based on the injection times.*

**B. Calibration**

1. File information:

Date of Calibration: *7/20/94*  
RRF20 Lab File ID: *EC7111*  
Date of Initial Calibration: *7/12/94*



**GC/MS Instrument Performance Check and Continuing Calibration #1**  
**Volatile Organic Fraction**  
**Page 2 of 4**

**2. Performance Check**

- a. Does the continuing calibration meet the criteria for the 23 volatile compounds and the system monitoring compounds?

Yes No

BA

Compound	Minimum RRF		Maximum %RSD	
Bromomethane	0.100		25.0	
Vinyl Chloride	0.100		25.0	
1,1-Dichloroethene	0.100		25.0	
1,1-Dichloroethane	0.200		25.0	
Chloroform	0.200		25.0	
1,2-Dichloroethane	0.100		25.0	
1,1,1-Trichloroethane	0.100		25.0	
Carbon Tetrachloride	0.100		25.0	
Bromodichloromethane	0.200		25.0	
cis-1,3-Dichloropropene	0.200		25.0	
Trichloroethene	0.300		25.0	
Dibromochloromethane	0.100		25.0	
1,1,2-Trichloroethane	0.100		25.0	
Benzene	0.500		25.0	
trans-1,3-Dichloropropene	0.100		25.0	
Bromoform	0.100		25.0	
Tetrachloroethene	0.200		25.0	
1,1,2,2-Tetrachloroethane	0.500		25.0	
Toluene	0.400		25.0	
Chlorobenzene	0.500		25.0	
Ethylbenzene	0.100		25.0	
Styrene	0.300		25.0	
Xylenes (total)	0.300		25.0	
Bromofluorobenzene (SMC)	0.200		25.0	

If no:

1. Circle the compound(s) that are outside the limits and enter their value(s)
2. If three or more analytes do not meet the %RSD and/or RRF criteria noted above, reject the continuing calibration and all associated field samples, QC samples, and blanks
3. If any RRF is less than 0.01, reject the continuing calibration and all associated field samples, QC samples, and blanks
4. If any %RSD is greater than 40%, reject the continuing calibration and all associated field samples, QC samples, and blanks.

**GC/MS Instrument Performance Check and Continuing Calibration #1**  
**Volatile Organic Fraction**  
**Page 3 of 4**

- b. Is the minimum RRF criteria of 0.010 met for the 12 compounds for which no %RSD has been established?

Yes      No

NA

Compound	RRF	Compound	RRF
Acetone		1,2-Dichloropropane	
2-Butanone		2-Hexanone	
Carbon Disulfide		Methylene Chloride	
Chloroethane		4-Methyl-2-pentanone	
Chloromethane		Toluene-d8	
1,2-Dichloroethene		1,2-Dichloroethane-d4	

If no,

- 1) Qualify the positive results of the non-SMC compounds in the associated samples, blanks and QC
- 2) No action for SMC compounds
- 3) Reject the non-detects for the non-SMC compounds in the samples, blanks, and QC
- 4) Circle the compounds that are outside of limits and enter values

**Comment:**

*Method 624 specifies %D limits for each compound. The %D were within these limits for all compounds.*

GC/MS Instrument Performance Check and Initial Calibration #1  
Volatile Organic Fraction  
Page 4 of 4

B. Calculations

For all calculations provide compound name, complete calculation, and report the laboratory result and the reviewer result

1. Show calculations for one %D

Compound:

Lab Value:

*No integration data or quantitation reports included in the data package, RRF cannot be calculated.*

2. Show calculation for RRF50 for one compound

Compound:

Lab Value:

*No integration data included in the data package, RRF cannot be calculated.*

C. Comments

**GC/MS Instrument Performance Check and Continuing Calibration #2**  
**Volatile Organic Fraction**  
**Page 1 of 4**

Site Name: Cytex Industries - Carteret, New Jersey

Associated Samples and Blanks:

*FB71394, CRT-1S, BD71494, CRT-7D, CRT-7S, CRT-6D, CRT-8D, CRT-8S*

**A. BFB GC/MS Instrument Performance Check (IPC)**

Injection Date: *7/21/94* Injection Time: *09:27* Instrument ID: *MSE*  
Heated Purge (Y/N): *N* Column: *DB-624* ID: *0.53* Data File: *EC368*

1. Is the BFB acceptable?

☒ Yes

No

2. Were all standards, samples, blanks and QC analyzed within 12 hours of the injection of the IPC?

☒ Yes

No

**B. Calibration**

1. File information:

Date of Calibration: *7/21/94*  
RRF20 Lab File ID: *EC138*  
Date of Initial Calibration: *7/12/94*

**GC/MS Instrument Performance Check and Continuing Calibration #2**  
**Volatile Organic Fraction**  
Page 2 of 4

2. Performance Check

- a. Does the continuing calibration meet the criteria for the 23 volatile compounds and the system monitoring compounds? Yes No

NA

Compound	Minimum RRF		Maximum %RSD	
Bromomethane	0.100		25.0	
Vinyl Chloride	0.100		25.0	
1,1-Dichloroethene	0.100		25.0	
1,1-Dichloroethane	0.200		25.0	
Chloroform	0.200		25.0	
1,2-Dichloroethane	0.100		25.0	
1,1,1-Trichloroethane	0.100		25.0	
Carbon Tetrachloride	0.100		25.0	
Bromodichloromethane	0.200		25.0	
cis-1,3-Dichloropropene	0.200		25.0	
Trichloroethene	0.300		25.0	
Dibromochloromethane	0.100		25.0	
1,1,2-Trichloroethane	0.100		25.0	
Benzene	0.500		25.0	
trans-1,3-Dichloropropene	0.100		25.0	
Bromoform	0.100		25.0	
Tetrachloroethene	0.200		25.0	
1,1,2,2-Tetrachloroethane	0.500		25.0	
Toluene	0.400		25.0	
Chlorobenzene	0.500		25.0	
Ethylbenzene	0.100		25.0	
Styrene	0.300		25.0	
Xylenes (total)	0.300		25.0	
Bromofluorobenzene (SMC)	0.200		25.0	

If no:

1. Circle the compound(s) that are outside the limits and enter their value(s)
2. If three or more analytes do not meet the %RSD and/or RRF criteria noted above, reject the continuing calibration and all associated field samples, QC samples, and blanks
3. If any RRF is less than 0.01, reject the continuing calibration and all associated field samples, QC samples, and blanks
4. If any %RSD is greater than 40%, reject the continuing calibration and all associated field samples, QC samples, and blanks.

**GC/MS Instrument Performance Check and Continuing Calibration #2**  
**Volatile Organic Fraction**  
**Page 3 of 4**

- b. Is the minimum RRF criteria of 0.010 met for the 12 compounds for which no %RSD has been established?

Yes No

NA

Compound	RRF	Compound	RRF
Acetone		1,2-Dichloropropane	
2-Butanone		2-Hexanone	
Carbon Disulfide		Methylene Chloride	
Chloroethane		4-Methyl-2-pentanone	
Chloromethane		Toluene-d8	
1,2-Dichloroethene		1,2-Dichloroethane-d4	

If no,

- 1) Qualify the positive results of the non-SMC compounds in the associated samples, blanks and QC
- 2) No action for SMC compounds
- 3) Reject the non-detects for the non-SMC compounds in the samples, blanks, and QC
- 4) Circle the compounds that are outside of limits and enter values

**Comment:**

*Method 624 specifies %D limits for each compound. The %D were within these limits for all compounds.*

GC/MS Instrument Performance Check and Continuing Calibration #2  
Volatile Organic Fraction  
Page 4 of 4

B. Calculations

For all calculations provide compound name, complete calculation, and report the laboratory result and the reviewer result

1. Show calculations for one %D  
Compound: Lab Value:

*No integration data or quantitation reports included in the data package, RRF cannot be calculated.*

2. Show calculation for RRF50 for one compound  
Compound: Lab Value:

*No integration data included in the data package, RRF cannot be calculated.*

C. Comments

**GC/MS Instrument Performance Check and Continuing Calibration #3**  
**Volatile Organic Fraction**  
**Page 1 of 4**

Site Name: Cytex Industries - Carteret, New Jersey

Associated Samples and Blanks:

*FB71594, TB, SW-2, SW-BD, SW-3, SW-1*

**A. BFB GC/MS Instrument Performance Check (IPC)**

Injection Date: *7/22/94* Injection Time: *09:44* Instrument ID: *MSE*  
Heated Purge (Y/N): *N* Column: *DB-624* ID: *0.53* Data File: *EC369*

1. Is the BFB acceptable? ☒ Yes ☐ No
2. Were all standards, samples, blanks and QC analyzed within 12 hours of the injection of the IPC? ☒ Yes ☐ No

**B. Calibration**

1. File information:

Date of Calibration: *7/22/94*  
RRF20 Lab File ID: *EC165*  
Date of Initial Calibration: *7/12/94*



**GC/MS Instrument Performance Check and Continuing Calibration #3**  
**Volatile Organic Fraction**  
**Page 2 of 4**

2. Performance Check

- a. Does the continuing calibration meet the criteria for the 23 volatile compounds and the system monitoring compounds? Yes No NA

Compound	Minimum RRF		Maximum %RSD	
Bromomethane	0.100		25.0	
Vinyl Chloride	0.100		25.0	
1,1-Dichloroethene	0.100		25.0	
1,1-Dichloroethane	0.200		25.0	
Chloroform	0.200		25.0	
1,2-Dichloroethane	0.100		25.0	
1,1,1-Trichloroethane	0.100		25.0	
Carbon Tetrachloride	0.100		25.0	
Bromodichloromethane	0.200		25.0	
cis-1,3-Dichloropropene	0.200		25.0	
Trichloroethene	0.300		25.0	
Dibromochloromethane	0.100		25.0	
1,1,2-Trichloroethane	0.100		25.0	
Benzene	0.500		25.0	
trans-1,3-Dichloropropene	0.100		25.0	
Bromoform	0.100		25.0	
Tetrachloroethene	0.200		25.0	
1,1,2,2-Tetrachloroethane	0.500		25.0	
Toluene	0.400		25.0	
Chlorobenzene	0.500		25.0	
Ethylbenzene	0.100		25.0	
Styrene	0.300		25.0	
Xylenes (total)	0.300		25.0	
Bromofluorobenzene (SMC)	0.200		25.0	

If no:

1. Circle the compound(s) that are outside the limits and enter their value(s)
2. If three or more analytes do not meet the %RSD and/or RRF criteria noted above, reject the continuing calibration and all associated field samples, QC samples, and blanks
3. If any RRF is less than 0.01, reject the continuing calibration and all associated field samples, QC samples, and blanks
4. If any %RSD is greater than 40%, reject the continuing calibration and all associated field samples, QC samples, and blanks.

**GC/MS Instrument Performance Check and Continuing Calibration #3**  
**Volatile Organic Fraction**  
**Page 3 of 4**

- b. Is the minimum RRF criteria of 0.010 met for the 12 compounds for which no %RSD has been established?

Yes      No

NA

Compound	RRF	Compound	RRF
Acetone		1,2-Dichloropropane	
2-Butanone		2-Hexanone	
Carbon Disulfide		Methylene Chloride	
Chloroethane		4-Methyl-2-pentanone	
Chloromethane		Toluene-d8	
1,2-Dichloroethene		1,2-Dichloroethane-d4	

If no,

- 1) Qualify the positive results of the non-SMC compounds in the associated samples, blanks and QC
- 2) No action for SMC compounds
- 3) Reject the non-detects for the non-SMC compounds in the samples, blanks, and QC
- 4) Circle the compounds that are outside of limits and enter values

**Comment:**

*Method 624 specifies %D limits for each compound. The %D were within these limits for all compounds.*

GC/MS Instrument Performance Check and Continuing Calibration #3  
Volatile Organic Fraction  
Page 4 of 4

## B. Calculations

For all calculations provide compound name, complete calculation, and report the laboratory result and the reviewer result

1. Show calculations for one %D  
Compound: Lab Value:

*No integration data or quantitation reports included in the data package, RRF cannot be calculated.*

2. Show calculation for RRF50 for one compound  
Compound: \_\_\_\_\_ Lab Value: \_\_\_\_\_

*No integration data included in the data package, RRF cannot be calculated.*

### C. Comments

**Internal Standard Area Summary**  
**Volatile Organic Fraction**  
**Page 1 of 3**

Site Name: Cytec Industries - Carteret, New Jersey

File ID: EC7111

	IS1	RT	IS2	RT	IS3	RT	QA Action
12 hour standard	19987	8.71	102711	11.07	78964	19.09	
upper limit	39974	9.21	205422	11.57	157928	19.59	
lower limit	9994	8.21	51356	10.57	39482	18.59	
Sample ID							
VBLK600	17942	8.69	94333	11.04	74164	19.06	
CRT-6S	13572	8.69	73806	11.07	61611	19.12	
CRT-3S	15909	8.68	6046	11.03	60787	19.05	
CRT-5S	14827	8.69	77722	11.02	61557	19.07	
FB71494	13923	8.69	74153	11.05	59395	19.09	
CRT-1S	12884	8.65	70763	11.01	58981	19.03	
TRIP BLANK	14140	8.70	77381	11.06	63773	19.10	
CRT-3D	14442	8.68	76410	11.04	63335	19.08	
CRT-4S	13905	8.68	71673	11.01	61012	19.06	
CRT-4D	13898	8.65	64247	11.01	55105	19.05	
CRT-5D	14704	8.70	76928	11.08	61909	19.12	
CRT-2S	14319	8.73	76266	11.09	62154	19.13	
CRT-2D	13821	8.72	71564	11.08	58550	19.12	
CRT-1D	14346	8.75	73688	11.13	61450	19.17	
CRT-3DMS	15730	8.75	83004	11.13	64664	19.15	
CRT-3DMSD	15422	8.76	83907	11.14	67015	19.19	

IS1 Bromochloromethane

IS2 1,4-Difluorobenzene

IS3 Chlorobenzene-d5

Internal Standard Area Summary  
Volatile Organic Fraction  
Page 2 of 3

Site Name: Cytec Industries - Carteret, New Jersey

File ID: >EC7138

	IS1	RT	IS2	RT	IS3	RT	QA Action
12 hour standard	19854	8.83	99311	11.19	76994	19.26	
upper limit	39708	9.33	198622	11.69	153988	19.76	
lower limit	9927	8.33	49656	10.69	38497	18.76	
Sample ID							
VBLK600	18768	8.70	90399	11.08	73650	19.13	
FB71394	16167	8.74	83197	11.13	65811	19.17	
BD71494	19316	8.74	107314	11.10	89516	19.12	
CRT-7D	21102	8.90	111912	11.26	89336	19.26	
CRT-7S	21200	8.69	115678	11.00	91080	19.07	
CRT-6D	20028	8.72	108523	11.10	85910	19.12	
CRT-8D	19783	8.74	112434	11.10	85778	19.14	
CRT-8S	18114	8.72	105591	11.06	86389	19.10	

IS1 Bromochloromethane

IS2 1,4-Difluorobenzene

IS3 Chlorobenzene-d5

Internal Standard Area Summary  
Volatile Organic Fraction  
Page 3 of 3

Site Name: Cytec Industries - Carteret, New Jersey

File ID: >EC7165

12 hour standard	IS1	RT	IS2	RT	IS3	RT	QA Action
	21783	8.76	118039	11.09	99724	19.11	
upper limit	43566	9.26	236078	11.59	199448	19.61	
lower limit	10892	8.26	59020	10.59	49862	18.61	
Sample ID							QA Action
VBLK600	24966	8.70	138155	11.08	110797	19.15	
FB71594	21164	8.72	107298	11.08	89602	19.10	
TB	19968	8.77	102198	11.13	83680	19.18	
SW-2	20761	8.79	104752	11.17	90162	19.14	
SW-BD	22289	8.71	115362	11.07	97446	19.12	
SW-3	18754	8.73	100212	11.06	83717	19.10	
SW-1	18906	8.74	91569	11.12	79606	19.11	
SW-1MS	19686	8.80	101935	11.15	86606	19.17	
SW-1MSD	22371	8.72	121864	11.05	99930	19.09	

IS1 Bromochloromethane

IS2 1,4-Difluorobenzene

IS3 Chlorobenzene-d5

**System Monitoring Compound Recovery Summary**  
**Volatile Organic Fraction**  
Page 1 of 2

Site Name: Cytec Industries - Carteret, New Jersey  
Matrix: groundwater

Sample ID	Tol-d8	4-BFB	DCA-d4	QA Action
CRT-6S	103	100	100	
CRT-3S	103	93	107	
CRT-5S	103	93	113	
FB71494	103	93	113	
CRT-1S	103	100	113	
TRIP BLANK	100	97	110	
CRT-4S	97	100	113	
CRT-4D	100	100	103	
CRT-5D	100	97	110	
CRT-2S	100	100	113	
CRT-2D	103	90	113	
CRT-1D	100	97	113	
CRT-3DMS	107	97	113	
CRT03DMSD	100	90	107	
FB71394	103	93	110	
BD71494	100	90	87	
CRT-7D	103	93	87	
CRT-7S	103	90	87	
CRT-6D	103	93	93	
CRT-8D	107	90	90	
CRT-8S	90	90	97	

Recovery Limits:

	Water	Soil
Toluene-d8 (Tol-d8)	88-110	84-138
4-Bromofluorobenzene (4-BFB)	86-115	59-113
1,2-Dichloroethane-d4 (DCA-d4)	76-114	70-121

## System Monitoring Compound Recovery Summary

## Volatile Organic Fraction

Page 2 of 2

Site Name: Cytec Industries - Carteret, New Jersey

Matrix: surface water

[illegible]

Recovery Limits:

## Water

## Soil

Toluene-d8 (Tol-d8)

88-110

84-138

4-Bromofluorobenzene (4-BFB)

86-115

59-113

1,2-Dichloroethane-d4 (DCA-d4)

76-114

70-121



**Matrix Spike/Matrix Spike Duplicate Analysis Summary**  
**Volatile Organic Fraction**  
Page 1 of 2

Site Name: Cytec Industries -  
Carteret, New Jersey  
Sample ID: CRT-3D

Matrix: groundwater  
Level: low

Compound	MS % Recovery	MSD % Recovery	RPD	Comments
1,1-Dichloroethene	95	85	11	
Trichloroethene	105	100	5	
Benzene	110	105	5	
Toluene	120	110	9	
Chlorobenzene	110	105	5	

Advisory Limits:

Compound	Water		Soil	
	%R	RPD	%R	RPD
1,1-Dichloroethene	61-145	14	59-172	22
Trichloroethene	71-120	24	62-137	24
Benzene	76-127	22	66-142	21
Toluene	76-125	13	59-139	21
Chlorobenzene	75-130	13	60-133	21

Comment:

*Method 624 requires that the matrix spike sample be spiked with all target compounds.*

**Matrix Spike/Matrix Spike Duplicate Analysis Summary**  
**Volatile Organic Fraction**  
Page 2 of 2

Site Name: Cytex Industries -  
Carteret, New Jersey  
Sample ID: SW-1

Matrix: surface water  
Level: low

Compound	MS % Recovery	MSD % Recovery	RPD	Comments
1,1-Dichloroethene	85	80	6	
Trichloroethene	110	95	15*	<i>no action</i>
Benzene	105	95	10	
Toluene	105	95	10	
Chlorobenzene	105	100	5	

Advisory Limits:

Compound	Water		Soil	
	%R	RPD	%R	RPD
1,1-Dichloroethene	61-145	14	59-172	22
Trichloroethene	71-120	14	62-137	24
Benzene	76-127	11	66-142	21
Toluene	76-125	13	59-139	21
Chlorobenzene	75-130	13	60-133	21

Comment:

*Method 624 requires that the matrix spike sample be spiked with all target compounds.*

Method Blank Summary  
Page 1 of 3

Site Name: Cytec Industries -  
Carteret, New Jersey

Fraction: *Volatile Organic*

Blank ID: *VLK 600-1*

File ID: *E7112*

Matrix: groundwater

Level: low

Extraction Date: NA

Analysis Date/Time: *7/20/94 10:06*

GPC Cleanup: No

Units: ug/l

Compound	Conc.	CRQL	QA Action

Associated Samples:

*CRT-6S, CRT-3S, CRT-5S, FB71494, CRT-1S, TRIP BLANK, CRT-3D, CRT-4S, CRT-4D, CRT-5D, CRT-2S, CRT-2D, CRT-1D*

Method Blank Summary  
Page 2 of 3

Site Name: Cytec Industries -  
Carteret, New Jersey

Fraction: *Volatile Organic*

Blank ID: *VLK 600-1*

File ID: *E7140*

Matrix: groundwater

Level: low

Extraction Date: NA

Analysis Date/Time: *7/21/94 11:06*

GPC Cleanup: No

Units: ug/l

Compound	Conc.	CRQL	QA Action

Associated Samples:

*FB71394, CRT-1S, BD71494, CRT-7D, CRT-7S, CRT-6D, CRT-8D, CRT-8S*

Method Blank Summary  
Page 3 of 3

Site Name: Cytec Industries -  
Carteret, New Jersey

Fraction: *Volatile Organic*

Blank ID: *VLK 600-1*

File ID: *E7168*

Matrix: groundwater

Level: low

Extraction Date: NA

Analysis Date/Time: *7/22/94 12:26*

GPC Cleanup: No

Units: ug/l

Compound	Conc.	CRQL	QA Action

Associated Samples:

*FB71594, TB, SW-2, SW-BD, SW-3, SW-1*

**Sample Result Verification**  
**Page 1 of 2**

Site Name: American Cyanamid - Bound Brook Facility

Associated Samples:

- |    |  |                                      |                                     |                                     |
|----|--|--------------------------------------|-------------------------------------|-------------------------------------|
| 1. | Was all sample data reported within the calibration range?                             | <input checked="" type="radio"/> Yes | <input type="radio"/> No            |                                     |
| 2. | Was the % moisture reported for all non-aqueous samples?                               | <input type="radio"/> Yes            | <input type="radio"/> No            | <input checked="" type="radio"/> NA |
| 3. | Was all non-aqueous sample data reported on a dry-weight basis?                        | <input type="radio"/> Yes            | <input type="radio"/> No            | <input checked="" type="radio"/> NA |
| 4. | Did any GC chromatograms or GC/MS RICs exhibit interferences?                          | <input type="radio"/> Yes            | <input checked="" type="radio"/> No |                                     |
| 5. | Did any sample data contain elevated detection limits that could not be accounted for? | <input type="radio"/> Yes            | <input checked="" type="radio"/> No |                                     |
| 6. | Were any computational or transcription errors found?                                  | <input type="radio"/> Yes            | <input type="radio"/> No            | <input checked="" type="radio"/> NA |

Sample Result Verification  
Page 2 of 2

7. Verify that the concentrations reported by the laboratory were correctly calculated. Recalculate the concentration of one analyte in each fraction.

VOLATILE FRACTION

Sample ID:  
Compound:

Lab Value:

*No integration data provided in the data package; therefore, no calculation of concentration can be performed.*





# **LEGEND**

- FENCE
- CRT-8 PROPOSED WELL CLUSTER LOCATION (APPROXIMATE)
- CRT-5 EXISTING WELL CLUSTER LOCATION (APPROXIMATE)
- SW-1 SURFACE-WATER SAMPLING LOCATIONS (APPROXIMATE)
- ROAD
- BERM
- PROPERTY LINE LOCATION (APPROXIMATE)

## **NOTES:**

1. ALL INFORMATION SHOWN HEREON UNLESS OTHERWISE NOTED WAS TAKEN FROM A MAP ENTITLED "ORIGINAL MANUSCRIPT AERIAL TOPOGRAPHY, WARNER'S PLANT IMPOUNDS", PREPARED BY MICHAEL DISKO ASSOCIATES, CONSULTING ENGINEERS, 2005 U.S. HIGHWAY No. 22, UNION, N.J. 07083, PREPARED FOR AMERICAN CYANAMID COMPANY, WARNER'S PLANT, LINDEN N.J. DATED APRIL 1992.
2. ROAD AND BERM LOCATIONS WERE TAKEN FROM A MAP ENTITLED "VEGETATION AND RESTORATION OF CONTAINMENT DIKE AT CARTERET LANDFILL", DRAWING No. SKW-157298, PREPARED BY AMERICAN CYANAMID COMPANY, DATED 5/3/88 AND REVISED 1/9/89.

200 0 200 400  
SCALE 1" = 200'



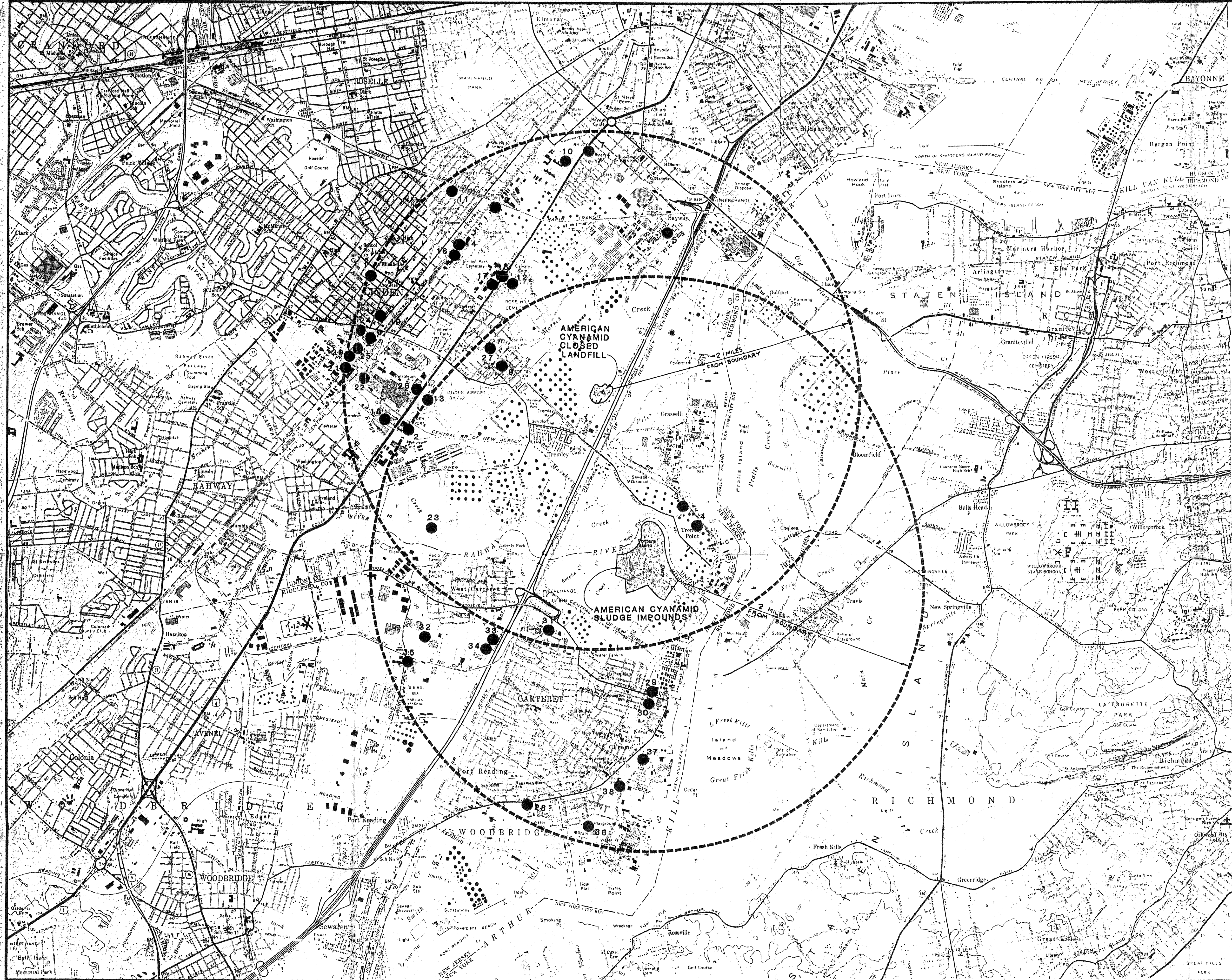
**BLASLAND, BOUCK & LEE, INC.**  
ENGINEERS & SCIENTISTS

CYTEC INDUSTRIES, INC.  
CARTERET IMPOUNDMENTS  
CARTERET, NEW JERSEY

REMEDIAL ACTION PLAN ADDENDUM

**SAMPLING LOCATIONS** **FIGURE 2-1**





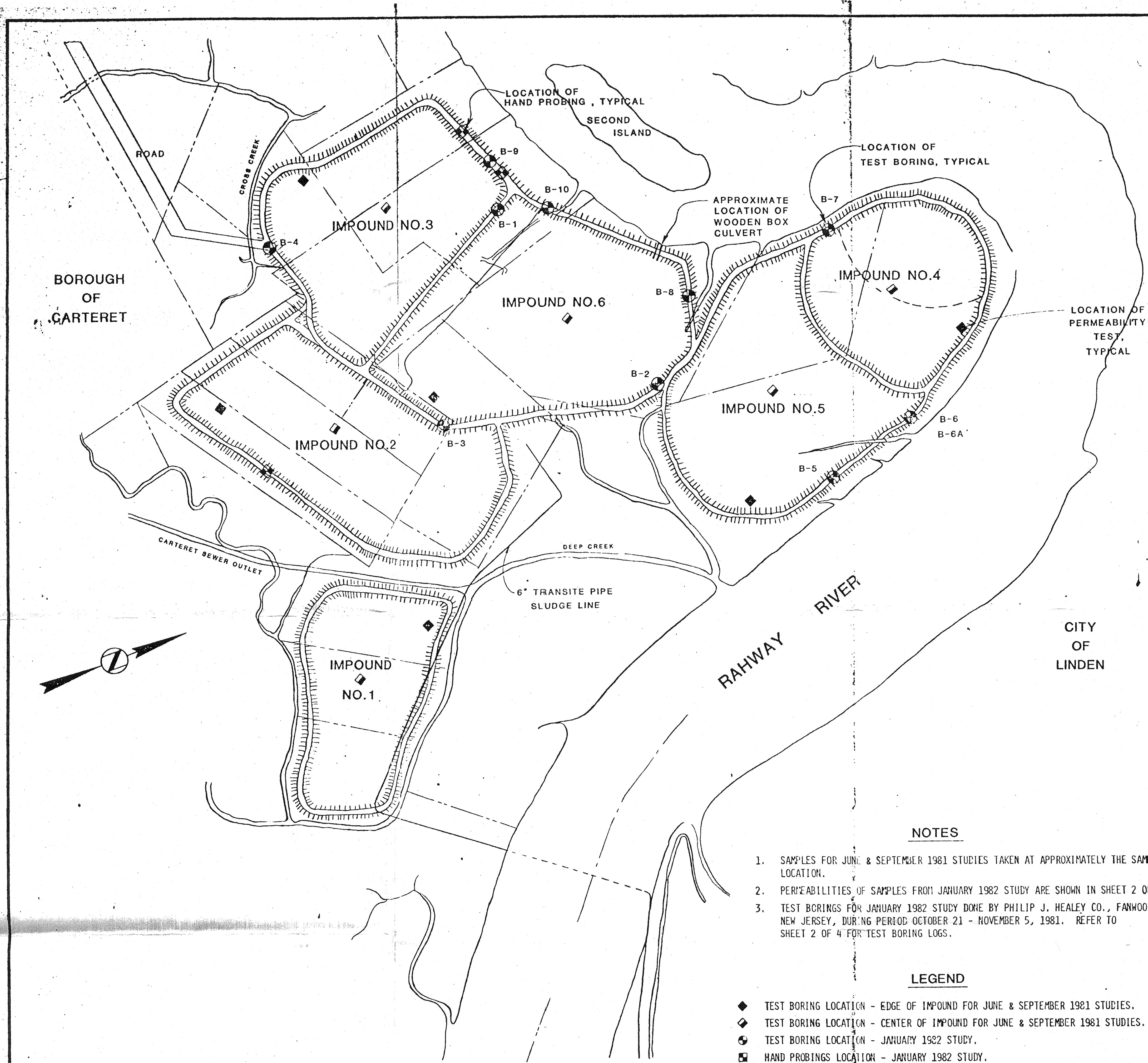
WELL DATA

WELL NO.	OWNER	YEAR DRILLED	DEPTH (FT.)
LINDEN			
1.	VINCENT PEZZUTO	1981	225
2.	SOLVENTS RECOVERY OF N.Y.	1981	23
		1981	22.5
3.	EXXON	1980	12
4.	CITGO	1981	20
5.	STANDARD OIL	1910	383
	STANDARD OIL		1566
6.	UNITED LACQUER	1947	500
7.	VOLUPTÉ, INC.	1935	368
8.	EASTERN PACKING CO.	1950	400
9.	LINDEN MILK CO.	1922	140
10.	PARK PLASTIC CO.	1950	255
11.	MORTON SAND	1949	155
12.	ROSEHILL CEM.	1909	209
13.	PACIFIC AIRMOTIVE CORP.	1950	300
14.	PA. RR STATION	1903	122
15.	W. MELANCHUK	1952	96
16.	LINDEN CEM. ASSOC.	1912	71
17.	HOLLYWOOD DR. IN	1950	170
18.	AUTOMOTIVE PROD. CREDIT ASSN.	1957	245
19.	LINDEN ICE CO.	1959	550
20.	APEX RENDEZVOUS	1972	440
21.	LAYNE, N.Y.	1955	306
22.	SMITH KESSLER	1965	360
23.	DOG POUND	1972	460
24.	NEWARK STEEL BARREL & DRUM CO.	1930	247
		1930	39
		1927	
		1937	208
25.	AIRLINE FOODS	1949	266
26.	DISTILLERS CO., LTD.	1934	316
		1934	306
27.	C H & JOHN WINANS	1903	200
		1903	146
CARTERET			
28.	EXXON	1981	25
29.	ROSELLE PLASTIC CORP.	1959	136
30.	VAHGUARD	1969	300
31.	GULF STREAM DEV.	1967	145
32.	WILGREEN IND.	1967	300
33.	METRO GLASS	1963	200
34.	EDWARD OGAREK	1965	100
35.	KAGON & DIXON CO.	1969	440
36.	UNITED STATES METALS & REF. CO.	1954	42
		1954	40
37.	AMER. AGRICULTURAL CHEMICAL CO.	1942	65
38.	CHROME STEEL CO.	1906	58

NOTE:  
REFER TO REPORT FOR MORE DETAILED WELL DATA.

REVISIONS	DESIGNED BY	B.R.	MICHAEL DISKO, P.E. PROFESSIONAL ENGINEER N.J. LICENSE NO. 12950 <i>Michael Disko</i> 1/8/82	M. DISKO ASSOCIATES CONSULTING ENGINEERS 2005 U.S. HIGHWAY NO. 22 P.O. BOX 1627 UNION, NEW JERSEY 07083	AMERICAN CYANAMID COMPANY WARNERS PLANT LINDEN, NEW JERSEY	PLAN SHOWING LOCATION OF N. J. D. E. P. REGISTERED WATER WELLS	SCALE
	DRAWN BY	R.G.C.					1"=2000FT.
	CHECKED BY	M.D.					DATE
							JANUARY 1982
							SHEET NUMBER
							3 OF 4





JUNE 1981 STUDY		
LOCATION	TOP SLUDGE LAYER	
	FIELD DENSITY LBS./CU.FT.	PERMEABILITY CM./SEC.
IMPOUND #1		
EDGE	88.80	$1.18 \times 10^{-4}$
CENTER	81.81	$8.67 \times 10^{-5}$
IMPOUND #2		
EDGE	38.42	$8.61 \times 10^{-5}$
CENTER	46.76	$9.05 \times 10^{-5}$
IMPOUND #3		
EDGE	81.88	$4.02 \times 10^{-5}$
CENTER	81.32	$2.83 \times 10^{-5}$
IMPOUND #4		
EDGE	61.98	$1.03 \times 10^{-4}$
CENTER	48.82	$8.73 \times 10^{-5}$
IMPOUND #5		
EDGE	39.70	$8.06 \times 10^{-5}$
CENTER	80.60	$3.28 \times 10^{-5}$
IMPOUND #6		
EDGE	86.47	$1.34 \times 10^{-5}$
CENTER	42.31	$1.82 \times 10^{-5}$

SEPTEMBER 1981 STUDY		
LOCATION	PERMEABILITY CM./SEC.	
	BOTTOM SLUDGE LAYER	UNDERLYING SOIL
IMPOUND #1		
EDGE	$1.49 \times 10^{-5}$	$1.07 \times 10^{-6}$
CENTER	$3.85 \times 10^{-5}$	$2.43 \times 10^{-6}$
IMPOUND #2		
EDGE	$1.87 \times 10^{-5}$	$8.00 \times 10^{-6}$
CENTER	$1.06 \times 10^{-5}$	$2.20 \times 10^{-7}$
IMPOUND #3		
EDGE	$2.68 \times 10^{-5}$	$1.63 \times 10^{-6}$
CENTER	$5.80 \times 10^{-6}$	$1.44 \times 10^{-6}$
IMPOUND #4		
EDGE	$8.07 \times 10^{-6}$	$6.34 \times 10^{-6}$
CENTER	$3.06 \times 10^{-5}$	$4.87 \times 10^{-6}$
IMPOUND #5		
EDGE	$8.00 \times 10^{-5}$	$3.87 \times 10^{-6}$
CENTER	$3.09 \times 10^{-5}$	$2.40 \times 10^{-7}$
IMPOUND #6		
EDGE	$9.15 \times 10^{-6}$	$4.12 \times 10^{-6}$
CENTER	$2.87 \times 10^{-5}$	$3.26 \times 10^{-7}$

- NOTES
1. SAMPLES FOR JUNE & SEPTEMBER 1981 STUDIES TAKEN AT APPROXIMATELY THE SAME LOCATION.
  2. PERMEABILITIES OF SAMPLES FROM JANUARY 1982 STUDY ARE SHOWN IN SHEET 2 OF 4.
  3. TEST BORINGS FOR JANUARY 1982 STUDY DONE BY PHILIP J. HEALEY CO., FANWOOD, NEW JERSEY, DURING PERIOD OCTOBER 21 - NOVEMBER 5, 1981. REFER TO SHEET 2 OF 4 FOR TEST BORING LOGS.

- LEGEND
- ◆ TEST BORING LOCATION - EDGE OF IMPOUND FOR JUNE & SEPTEMBER 1981 STUDIES.
  - ◇ TEST BORING LOCATION - CENTER OF IMPOUND FOR JUNE & SEPTEMBER 1981 STUDIES.
  - TEST BORING LOCATION - JANUARY 1982 STUDY.
  - HAND PROBINGS LOCATION - JANUARY 1982 STUDY.

JANUARY 1982 STUDY			
LOCATION	TOTAL BOREHOLE DEPTH, FT.	TOTAL DIKE MATERIAL DEPTH, FT.	REMARKS
B-1	38	13	FILL OVERLIES 5 FT. SLUDGE
B-2	33	33	NO SLUDGE OR MEADOW MAT ENCOUNTERED
B-3	39	19	FILL OVERLIES 4 FT. SLUDGE
B-4	29	5	FILL OVERLIES 5 FT. SLUDGE
B-5	28	10	SLUDGE ABOVE AND BELOW FILL
B-6	18	1.5	SLUDGE ABOVE AND BELOW FILL
B-6A	21	9	SLUDGE ABOVE AND BELOW FILL
B-7	18	16	FILL ABOVE AND BELOW SLUDGE
B-8	24	22	FILL LIES ON MEADOW MAT
B-9	10	0	NO FILL. SLUDGE LIES ON MEADOW MAT
B-10	24	24	FILL LIES ON MEADOW MAT

DESIGNED BY B.R.		MICHAEL DISKO, P.E. PROFESSIONAL ENGINEER N.J. LICENSE NO. 12950 <i>Michael Disko</i> 1/8/82	M. DISKO ASSOCIATES CONSULTING ENGINEERS 2005 U.S. HIGHWAY NO. 22 P.O. BOX 627 UNION, NEW JERSEY 07083	AMERICAN CYANAMID COMPANY WARNER'S PLANT LINDEN, NEW JERSEY	LOCATION OF TEST BORINGS & PERMEABILITY TESTS	SCALE 1"=200'				
DRAWN BY M.D.D.						DATE JANUARY 1982				
CHECKED BY M.D.						SHEET NUMBER OF 4				
REVISIONS										



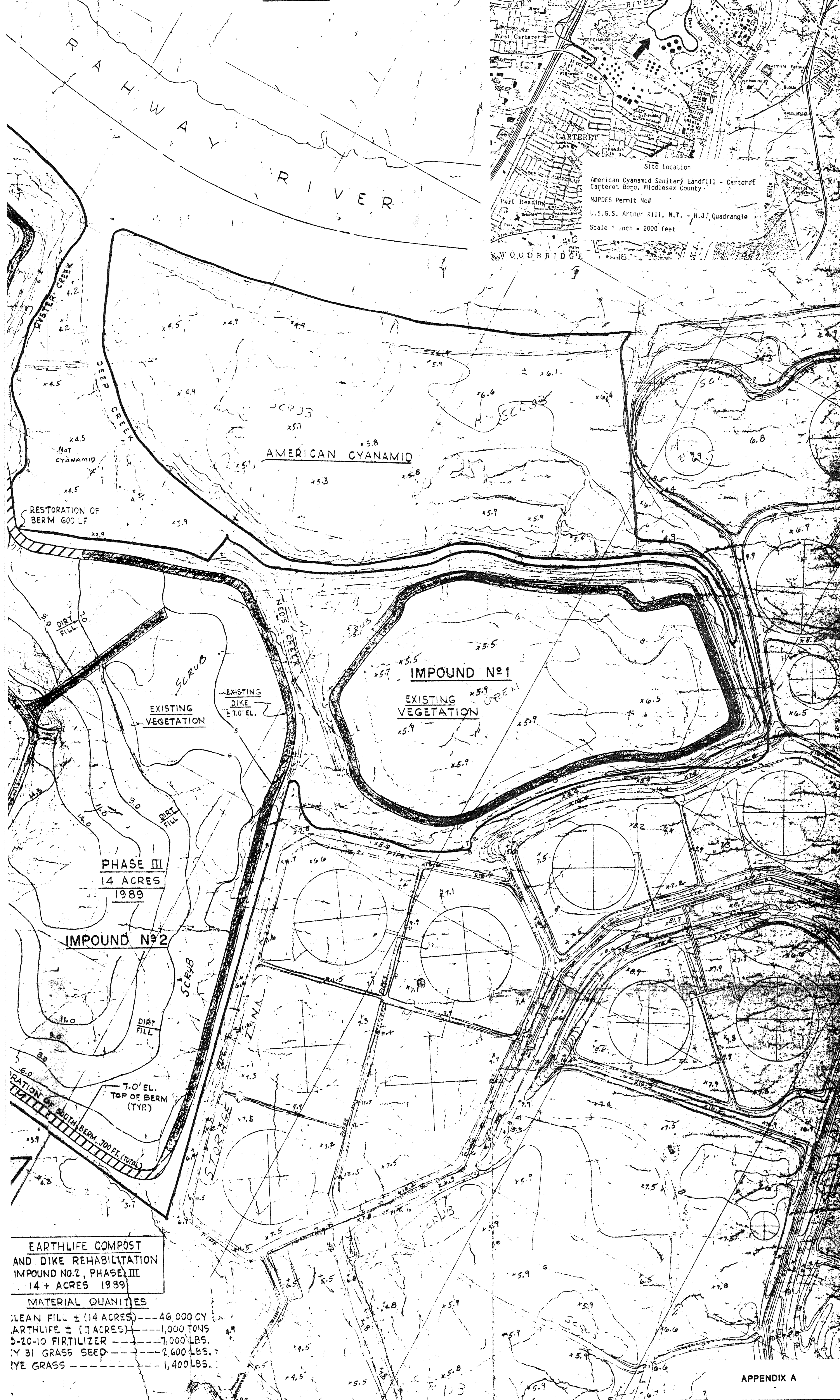
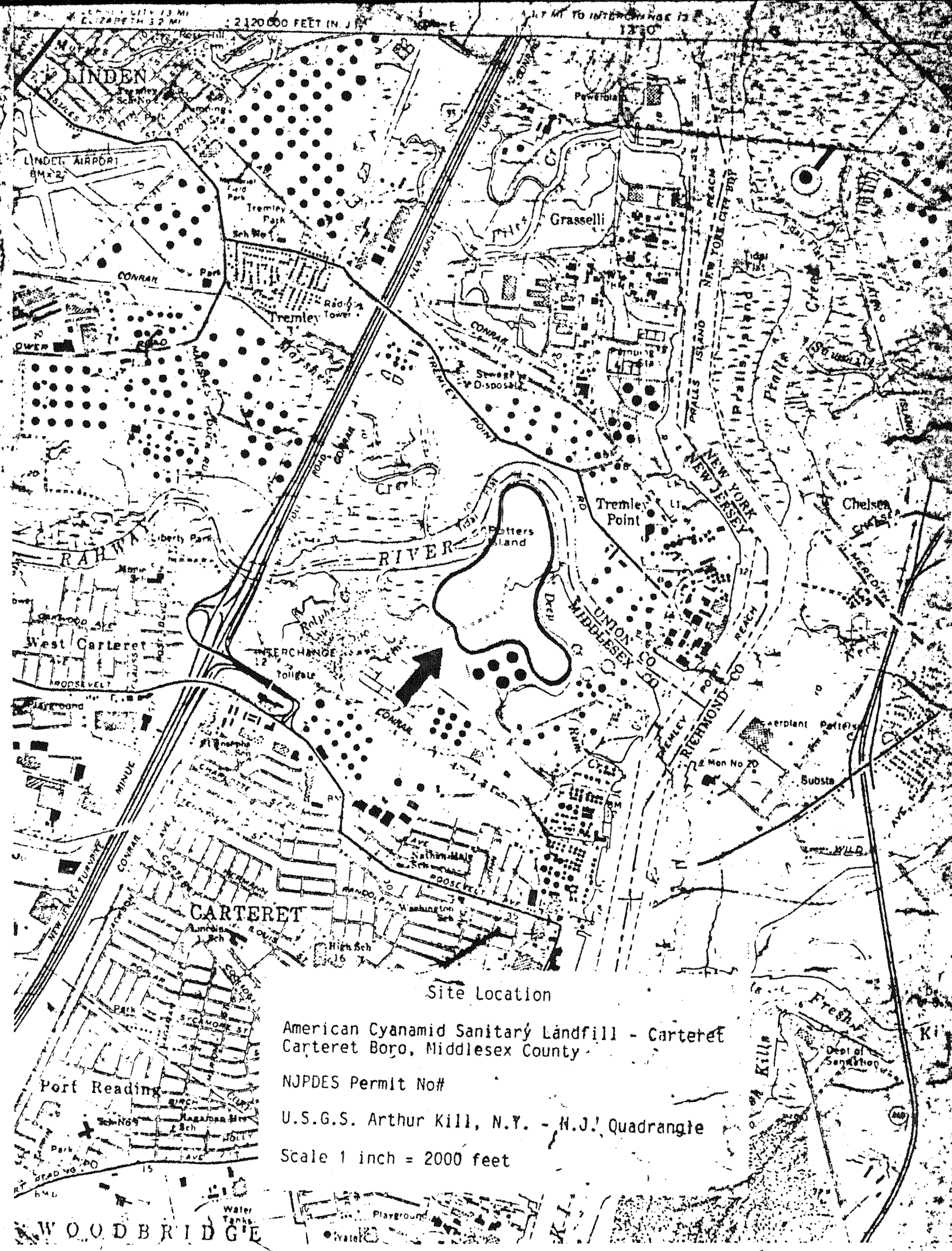
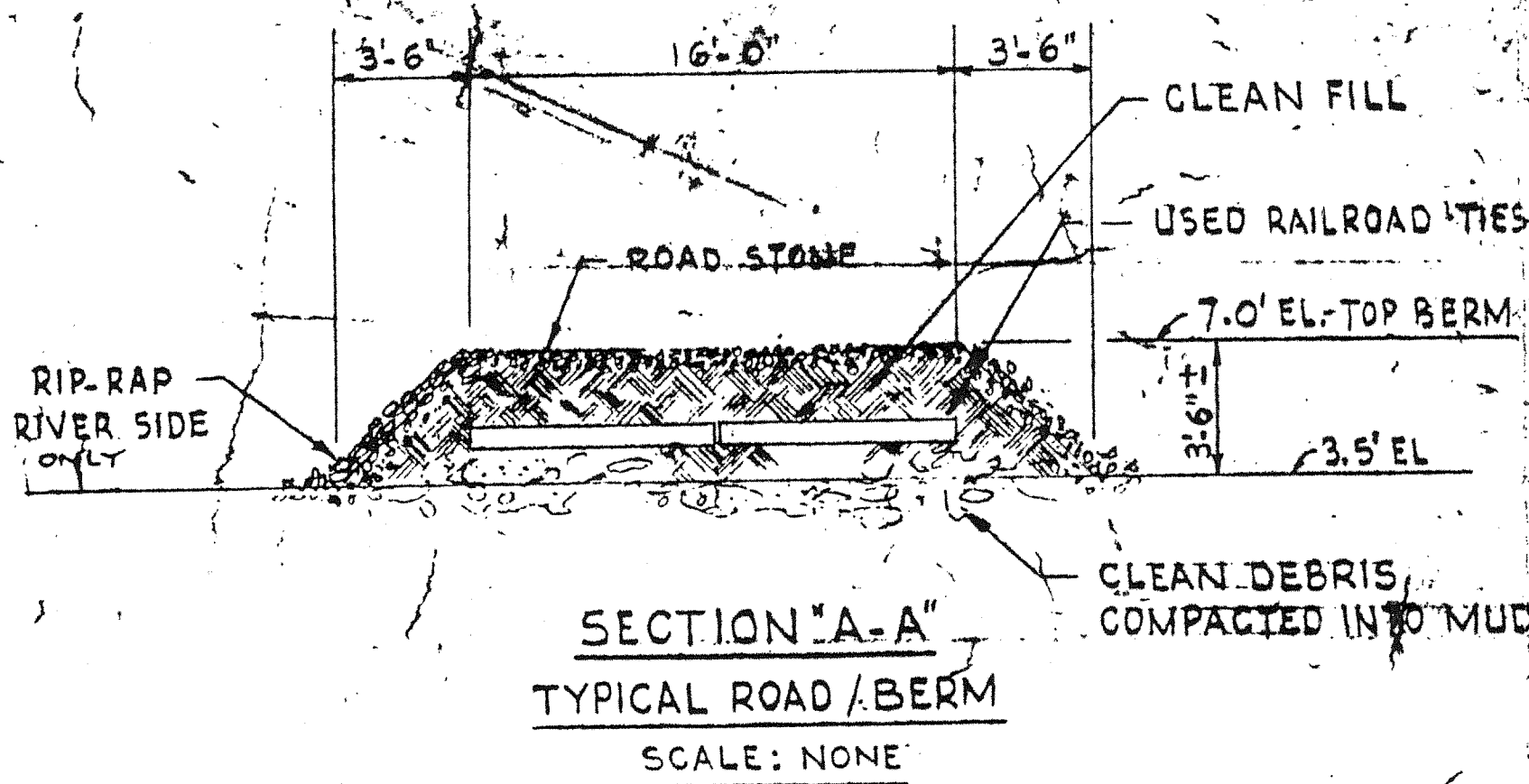


**LEGEND**

- EXIST. ROADWAY / BERM
- RECON. ROADWAY / BERM
- PHASE II AND III
- CAST-OUT MATERIAL RETURNED TO IMPOUND NO. 6

DESIGNED BY					
DRAWN BY					
CHECKED BY	M.D.	1-9-93	PROPOSED REVEGETATION OF IMPOUND NO. 3 & 6, PHASE II	AS BUILT IMPOUND NO. 3 & 6, PHASE II	APPROVED
REV.	DATE		DESCRIPTION		





**EARTHLIFE COMPOST AND DIKE REHABILITATION IMPOUND NO. 2, PHASE III 14 + ACRES 1989**

**MATERIAL QUANTITIES**

CLEAN FILL ± (14 ACRES)	46,000 CY
EARTHLIFE ± (7 ACRES)	1,000 TONS
5-20-10 FERTILIZER	7,000 LBS.
1/2" 31 GRASS SEED	2,600 LBS.
RYE GRASS	1,400 LBS.

APPENDIX A

<b>AMERICAN CYANAMID COMPANY</b> <b>WARNER'S PLANT</b> <b>LINDEN, NEW JERSEY</b>		<b>VEGETATION AND RESTORATION OF CONTAINMENT DIKE AT CARTERET LANDFILL</b>		SCALE HORIZ. 1" = 100' VERT. 1" = 100' DATE 5/1/88
DRAWN N. BUDAY CHECKED <i>MB</i>		DATE 8-18-88 DATE 8/3/88		SHEET NUMBER 1 OF 1
PROFESSIONAL ENGINEER J.J. LICENSE		SIGNATURE DATE		PC-601 SKW-15729